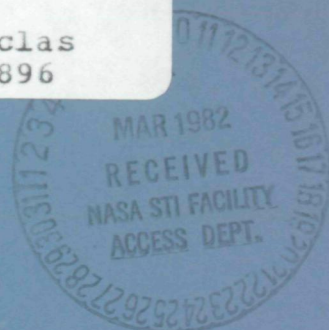


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AERONAUTICAL ENGINEERING

A Continuing Bibliography

Supplement 143

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in December 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
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INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering -- A Continuing Bibliography* (NASA SP-7037) lists 254 reports, journal articles, and other documents originally announced in December 1981 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* and *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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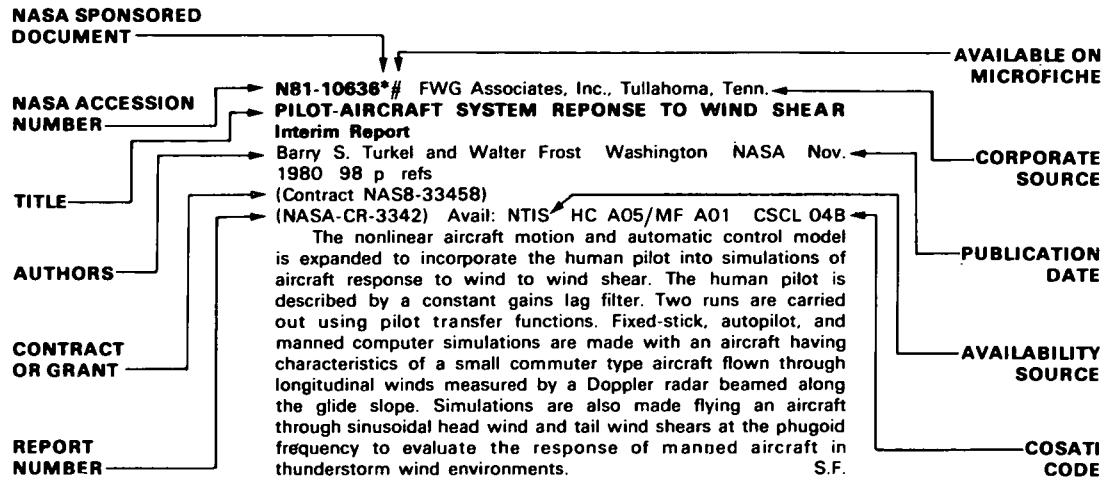
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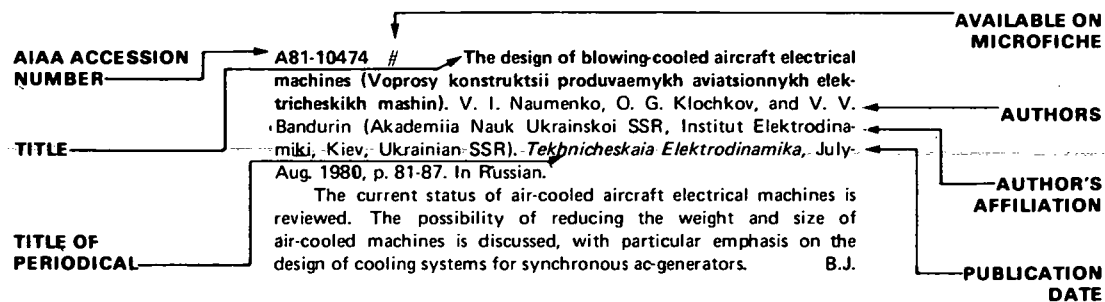
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AERONAUTICAL ENGINEERING

A Continuing Bibliography (Suppl. 143)

JANUARY 1982

IAA ENTRIES

A81-47142 Aircraft recognition by means of monostatic radar (Signature d'avions à l'aide du radar monostatique). J.-Y. Mevel and G. Launay (Rennes I, Université, Rennes, France). (*Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etude sur la Reconnaissance des Formes et Signatures Radar, Paris, France, Jan. 30, 1980.*) *Annales des Télécommunications*, vol. 36, May-June 1981, p. 347-358. 16 refs. In French.

Consideration is given to the potential for aircraft recognition using a monostatic radar receiving echoes from the aircraft surface. The reconstruction of aircraft attitude with respect to a monostatic radar based on radar-derived trajectory data and wind data is examined and the parameters observable based on the radar echo are considered in relation to the possibility of shape recognition. It is shown that, although the geometrical reconstruction of aircraft shape by the classical monostatic tracking radar is probably impossible, signature identification may be possible through extended observation and comparison with a data bank. A signal analyzer used in an experimental study of aircraft identification by a tracking radar is then described and results of spectral analysis of measurements performed on a variety of propeller and jet aircraft are illustrated.

A.L.W.

A81-47143 An original method for the analysis of the power diffraction pattern of a radar target for shape recognition purposes (Méthode originale d'analyse du diagramme de diffraction en puissance d'une cible radar en vue de la reconnaissance des formes). J. Saillard and G. Chassay (Rennes I, Université, Rennes, France). (*Société des Electriciens, des Electroniciens et des Radioélectriciens, Journée d'Etude sur la Reconnaissance des Formes et Signatures Radar, Paris, France, Jan. 30, 1980.*) *Annales des Télécommunications*, vol. 36, May-June 1981, p. 359-368. In French.

The modeling of an airborne radar target is currently accomplished by the replacement of the object by a number of appropriately distributed bright points. The present paper considers the number of bright points necessary for the proper representation of a radar objective and the effective far-field radar cross section of a system modeled by an ensemble of bright points in relation to the problem of target shape recognition. It is shown that the effective cross section may be expressed as the sum of interference patterns of each possible set of two bright points. Consideration of the bipoint interference functions reveals that they can in turn be represented by a combination of Chebyshev polynomials of the first and second kinds, which can be reduced to an amplitude-modulated circular function and used to derive object dimensions by means of Fourier analysis. An example is presented of the analysis of a specific linear isotropic multipoint.

A.L.W.

A81-47268 # A formulation of the shimmy problem for swiveling wheels (Ob odnoi postanovke zadachi o shimmi orienuishchikhsia koles). V. I. Goncharenko, L. G. Lobas, and N. V. Nikitina (Akademiiia Nauk Ukrainskoi SSR, Institut Mekhaniki, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika*, vol. 17, Aug. 1981, p. 82-88. 8 refs. In Russian.

Equations of motion are derived for a two-wheel landing gear strut with independently rotating wheels and an oblique alignment axis of the swivel on the basis of an improved version of the formulation proposed by Keldysh (1945). In the present approach, the complex parameter I used in the Keldysh formulation is ignored

but, instead, an additional degree of freedom (in the lateral direction) is introduced. Although this results in higher dimensionality of the configuration space and higher order of the system of differential equations, the experimental determinations of the landing gear alignment become unambiguous.

V.L.

A81-47425 * Annual survey of spaceflight safety systems: 11th supplement. Survey period - July 1980-June 1981. N. E. Brown and J. W. Brown (NASA, Johnson Space Center, Houston, TX). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-251*. 22 p. 13 refs.

Reports in the field of space flight safety applicable to current and future operational space activities which appeared between July 1980 and June 1981 are surveyed. Subjects in the area of flight rescue and safety during launch, on-orbit, reentry and landing phases include the major activities and findings of the first Shuttle test flight, a slidewire system for emergency egress from the Space Shuttle on the launch pad, and the testing of the Spacelab engineering model. In the area of human capabilities and crew roles, attention is given to reports of repairs to the Salyut 6 space station made by a Soyuz crew, and an assessment of weightlessness effects on space worker health and safety. Safety requirements for STS payloads including pressure vessels, and the Orbiter window system and for spacecraft testing are also presented, along with those for a television system to aid in monitoring astronaut extravehicular activities. For the operation of large space structures, reports include EVA equipment for satellite servicing and the safety aspects of connectors used in construction. Finally, attention is given to safety-related criteria in a study of Shuttle interactions with the proposed Space Operations Center.

A.L.W.

A81-47533 # Errors of phase VLF-navigation systems under conditions of auroral disturbances (Ob oshibkakh sistem fazovoi SDV-navigatsii v usloviakh avroral'nykh vozmushchenii). M. I. Beloglazov. *Radiotekhnika*, vol. 36, July 1981, p. 32-34. 5 refs. In Russian.

Experimental data on the operation of VLF navigation systems at high latitudes under conditions of the quiet and disturbed auroral ionosphere are analyzed. It is shown that the mean-square errors of position determination at distances of 6000-7000 km at high latitudes are 5-6 times greater than at midlatitudes. At distances of about 1000 km, errors at high latitudes are twice as great as those at midlatitudes for quiet conditions and four times greater than those at midlatitudes for disturbed conditions.

B.J.

A81-47551 # Development of the carbon fiber-reinforced side rudder for the Airbus (Entwicklung eines kohlefaserverstärkten Seitenruders für den Airbus). D. Schulz (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-055*. 15 p. In German. Research supported by the Bundesministerium für Forschung und Technologie and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt. (MBB-UT-07-81)

Carbon-fiber-reinforced component parts have been developed to reduce aircraft weight, and thus render the aircraft more fuel efficient. The A310, designed for use by 1983, has spoilers, rudders, nose pieces, and fairings constructed of the carbon-fiber-reinforced material, which makes possible a 20% weight reduction over conventional components of light metals. Side rudders of the A300 and the A310 are compared, and goals such as an 18% weight

reduction, acceptable maintenance costs, and similar manufacturing and safety standards are discussed. Construction limitations are considered, and material-specific problems are examined, including electrolytic corrosion, machinability, and the effects of humidity and temperature. Component tests are also conducted. It is found that the use of the carbon-reinforced component parts on aircraft as large as the A310 can lead to a 6000 kg weight reduction, with a yearly savings of 45 million D.M. for a fleet of 30 aircraft. D.L.G.

A81-47552 Active gust- and maneuver load control concepts, taking into account, as example, the Airbus A300. I - Design of a controller in the temporal domain for the alleviation of gust loads and the control of the effectiveness for stochastic gusts (Aktive Böen- und Manöverlastregelungs-Konzepte am Beispiel des Airbus A 300. I - Auslegung eines Reglers im Zeitbereich zur Böenlastminderung und Nachprüfung der Wirksamkeit für stochastische Böen). J. Becker, O. Sensburg, and F. Weiss (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-065A*. 55 p. 12 refs. In German. (MBB-FE-172/S/PUB/39)

An active gust load control concept was designed for an Airbus configuration with 10% span extension. The design was made in the temporal domain on the basis of a quasi-steady representation of the aerodynamics for a rigid-elastic aircraft. Maximum values for wing load reduction were determined for a specific case, taking into account the control of external aileron, spoilers, and the elevator. An inspection of the effectiveness of the designed control concepts was performed in the frequency range for stochastic gusts. Attention is given to results of flutter calculations, the relation between alleviation of gust load and damping of flutter, and the bending moment characteristics. G.R.

A81-47553 Active gust- and maneuver load reduction concepts, taking into account, as an example, the Airbus A300. II - Design of a controller for gust and maneuver load reduction in the frequency range (Aktive Böen- und Manöverlastminderungs-Konzepte am Beispiel des Airbus A300. II - Auslegung eines Reglers zur Böen- und Manöverlastminderung im Frequenzbereich). G. Beck (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-065B*. 27 p. 7 refs. In German. (MBB-UT-08-81)

A system which reduces surface loading due to vertical gusts and longitudinal maneuvers is considered. The employment of such a system in connection with an aircraft provides an approach for increasing the payload or the range of the aircraft. An investigation is conducted to explore the feasibility of using such an approach in the case of the A300 variant TA9. It is intended to retain the present wing structure of the A300B4 for the new design. Compared to the B4, the new aircraft is to have an extended wing tip and a greater payload. Currently existing A300 control surfaces are to be employed. The design of the controller for implementing the new system is discussed, taking into account an open and a closed loop system. The load reducing potential is determined along with the interior aileron, the three external spoilers, and the exterior aileron. G.R.

A81-47554 # The calculation of transonic blade tip flow at helicopter rotors (Zur Berechnung der transsonischen Blattspitzenströmung bei Hubschrauberrotoren). H. Stahl and V. Mikulla (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-025*. 26 p. 11 refs. In German. (MBB-UD-320-81-OE)

Differences regarding the flow around the wing for fixed-wing and rotor-wing aircraft are discussed. A description is presented of results which were obtained with the aid of a rotor computational program based on the (two-dimensional) blade-element theory. The particular problem regarding the theoretical treatment of the flow around the blade tip is related to the characteristics of this flow, which is three-dimensional, unsteady, and becomes transonic on the advancing blade in the case of high forward speeds. Theories based on potential theory are discussed, although the assumptions of the theories are not satisfied at the rotating wing. Calculations using such procedures show, however, that the representation of the real flow relations at the blade tip is quite good. The procedures have the

disadvantage of very long computation times. Attention is also given to a three-dimensional computational procedure of fixed-wing aerodynamics, which has been modified for a utilization in rotor calculations by introducing a Mach number gradient along the rotor radius. G.R.

A81-47555 # The calculation of separated flow at helicopter bodies (Zur Berechnung der abgelösten Strömung an Hubschrauber-rümpfen). G. Polz (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-026*. 26 p. 17 refs. In German. (MBB-UD-321-81-OE)

In the case of helicopters, it is not always possible to avoid flow separation with wake formation at the rear of the fuselage. The wake region makes an analytical computation of the flow with the methods of the potential theory impossible. A survey of existing procedures for separated fuselage flows is provided, and a description is given of a computational model which is based on a combination of panel and boundary-layer computational procedures. The model makes use of a trailing body with uniform circulation distribution to simulate the wake region. The possibilities provided by the procedure are illustrated with the aid of pressure distribution and flowfield calculations. Results obtained in wind tunnel and flight tests are also shown. G.R.

A81-47556 Design and construction of a model which is dynamically similar to the A310 wing (Auslegung und Bau eines dynamisch ähnlichen modells des A 310 Flügels). H. Hönlinger (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-035*. 31 p. In German. (MBB-FE-17/S/PUB/42)

In investigations conducted to evaluate the flutter characteristics of a wing with supercritical profile, it is necessary to take, for the transonic domain, into consideration also the effect of the steady angle of attack. An experimental verification of this effect requires a wind tunnel study of flutter models with particularly accurate profile geometry. A description is presented of the design and the construction of a flutter model for the A310 wing with supercritical profile. The requirements for the design of the model, in scale of 1:20, included, in addition to a high profile accuracy, also a simple and cost-effective method of construction. In the selected design, the stiffness distribution in the model is simulated by means of a simple steel box. Profile geometry and model mass distribution are imitated with the aid of a foam structure, covered with a glass-fiber laminate. A finite-element model was used for the design of a complex propulsion unit suspension, which was idealized by means of profile beams. G.R.

A81-47557 Surface-oriented coordinates for boundary-layer calculations in the case of general configurations (Oberflächenorientierte Koordinaten für Grenzschichtberechnungen an allgemeinen Konfigurationen). E. H. Hirschel (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-014*. 26 p. 5 refs. In German. (MBB-FE-122/S/PUB/41)

The calculation of three-dimensional boundary layers requires the selection of a suitable coordinate system. A description is presented of an approach for obtaining surface-oriented, curvilinear, nonorthogonal, locally monoclinic coordinates for general wing and body configurations. It is shown that the boundary-layer coordinates for calculations of the first order present a special case of these coordinates. Metric tensor and curvature tensor of the surface are discussed, and relations are given for the transformation of Cartesian components of the frictionless external flow into boundary-layer coordinates. The employed tensorial concepts are used in the formulation of the boundary layer equations, and for the calculation of the streamlines of the frictionless external flow and boundary-wall streamlines. The application of the considered concepts is illustrated with the aid of specific examples of boundary-layer calculations involving aircraft wings and bodies. G.R.

A81-47562 # Estimation of kinetic quantities of flight mechanics with a nonlinear observer (Schätzung flugmechanischer Bewegungsgrößen mit einem nichtlinearen Beobachter). H. Seidel (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany).

Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-067. 26 p. 18 refs. In German.

Investigations have been conducted regarding the employment of linear observers for a surveillance or a replacement of transducers. The considered study is concerned with an attempt to employ in the observer a nonlinear model in place of the linear one. The motivation for the study is related to the nonlinear characteristics of the mathematical models for the motions of flight mechanics. An adaptation of the model to the current flight conditions, which is necessary in the case of linear models, will not be needed if a nonlinear model is employed. The estimation of the variables of state for the longitudinal motion of the aircraft is discussed. The nonlinear differential equations which describe the symmetrical motion of an aircraft are considered, taking into account the state parameters airspeed, angle of attack, pitch (inclination), and pitch rate. Simulation results are presented, giving attention to steady and unsteady aerodynamic flight characteristics, and disturbances produced by gusts. A test shows that an estimate of the angle of attack with an accuracy of approximately 1 deg is possible. G.R.

A81-47563 # European transonic wind tunnel ETW - Status of the project at the end of the predesign phase (Europäischer Transsonischer Windkanal ETW - Stand des Projektes am Ende der Vorentwurfsphase). W. Schröder. *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-027. 27 p. 24 refs. In German.*

The predesign of the Basis ETW with a test cross-section area of 3.2 sq m and a maximum pressure of 4.5 bar was completed in spring 1980. The need for a European transonic wind tunnel for conducting tests at high Reynolds numbers is discussed, taking into account current wind-tunnel developments in Europe and the U.S. The specifications for the ETW are considered. The maximum Reynolds number for the ETW has been raised to a value of 50 million. This was done to enhance the cost effectiveness of testing in the ETW and to reduce development risks. The ETW will, therefore, provide for future European aircraft developments conditions for full-scale testing over a wide flight range. Attention is given to the performance spectrum of the ETW, an evaluation of the predesign, operational aspects of the ETW, the thermal inertia of the model, the pilot wind tunnel, the cryogenic technology program, and the future phases of the ETW program. G.R.

A81-47564 # Measures for increasing the service life of riveted, aircraft-relevant joints (Massnahmen zur Lebensdauererhöhung flugzeugrelevanter Passnietfügungen). L. Schwarmann (Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-052. 16 p. 10 refs. In German.*

Proof of the service life of structural components exposed to dynamic stresses is required in connection with the design of supporting structures for an aircraft. It has been found that the service life of such components is often determined by the ability of the riveted joints to withstand the operational stresses. The reported investigation is, therefore, concerned with approaches which make it possible to increase the service life of the riveted joints. Analytical and experimental investigations regarding the feasibility of two approaches for prolonging the service life of riveted joints are discussed, taking into account studies conducted with a test bar which is representative for aircraft-construction applications. One approach makes use of a press fit for rivet and hole. The second approach involves strain hardening of the rivet hole before driving the rivet. G.R.

A81-47565 # Recognizing defects in carbon-fiber-reinforced plastics (Erkennbarkeit von Fehlern in CFK-Laminaten). R. Schütz and W. Hillger (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Strukturmechanik, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-057. 20 p. In German.*

The damage tolerance of structures made of carbon-fiber-reinforced plastic is tested under various loads. Test laminate (73/1/1, 24/9/1, 1465 A) specimens of thickness 1.5-3.2 mm with various defects were subjected to static and dynamic loads. Special

attention was given to delamination, and ultrasonic C-scans were made on the specimens. It was shown that cracks from even small defects can be detected with great accuracy. The same probes were also X-rayed; defects that could not be detected under ordinary X-rays were bored and studied under vacuum by a contrast technique. The nondestructive ultrasonic and X-ray tests were controlled by partially destructive tests, and good agreement was observed between the two. J.F.

A81-47580 # Employment of development simulation for the realization of direct side force control in the case of an attack aircraft (Einsatz der Entwicklungssimulation bei der Realisierung einer direkten Seitenkraftsteuerung an einem Kampfflugzeug). U. Nortmann and H. J. Munser (Dornier GmbH, Friedrichshafen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-063. 50 p. 21 refs. In German.*

Direct side force control (DSFC) has been realized in the case of the Alpha Jet. The program used for the implementation of DSFC is discussed, taking into account the program status before the flight test. Attention is given to the Alpha Jet fixed-seat simulator used as flight simulator, the first simulation investigations for DSFC, employment simulations involving the use of DSFC, development simulations for the determination of the required damping systems (DS), simulations for the determination of specification data for DSFC elements and onboard installations, and simulations with DSFC-DC hardware. The application range of simulation methods for the development of modern attack aircraft is examined. G.R.

A81-47585 # Instrumentation for measurement of flow properties on a swept wing in flight. A. Bertelrud (Flygtekniska Forsöksanstalten, Bromma, Sweden). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-034. 31 p. 16 refs.*

Flight tests are performed to measure flow properties on a swept wing to improve methods of extrapolating wind tunnel results, and to obtain data supporting the development of computational methods. The approach to the flight test is described with emphasis on the differences in results obtained during wind tunnel testing of fluid flow properties. Problems in flight testing of aerodynamic flow are considered, including flight conditions, unsteadiness, flexibility, heat flux, and nonrepeatability. Experiments using a swept-wing attack aircraft with a 35 deg sweep of the 25% chord line are conducted, indicating static pressure in the leading edge and wing tip regions. The data acquisition system on the laboratory aircraft is described with data from reference and aerodynamic probes. The system is found to allow correlations to be performed with the flight mechanical and structural aspects of the aircraft, and it is shown how the access to a large computer is essential in such testing. D.L.G.

A81-47587 # The half-model technique in the wind tunnel and its employment in the development of the Airbus family (Die Halbmodelltechnik im Windkanal und ihre Anwendung bei der Entwicklung der Airbus-Familie). H. P. Franz (Vereinigte Flugtechnische Werke GmbH, Bremen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-118. 38 p. In German.*

The half-model technique for conducting measurements in the wind tunnel is particularly suited for the development of large transport aircraft. The technique is especially useful in connection with the determination and the improvement of the aircraft characteristics related to takeoff and landing operations. Expenses for models are reduced and the obtainable Re-numbers are increased by the factor two. Drawback of the considered technique are also discussed, giving attention to the very exacting requirements for obtaining results having absolute accuracy, and the impossibility to study lateral motions. Details of applications of the half-model technique to Airbus family development projects are examined. G.R.

A81-47595 # The influence of the airspeed on jet turbulence and the consequences for the jet noise (Einfluss der Fluggeschwindigkeit auf die Turbulenz im Triebwerksstrahl und seine Folgen für den Strahlärm). U. Michel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Experimentelle Strömungsmechanik, Berlin, West Germany). *Deutsche Gesellschaft für Luft-*

und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-021. 15 p. 10 refs. In German.

The turbulence in a free jet is the cause of jet noise and consequently a study of the effect of airspeed on jet noise must take into consideration the influence of the airspeed on the turbulence. A model for the description of free jet turbulence is discussed, taking into account investigations reported by Ffowcs Williams (1963) and Michalke (1979). According to Michalke, it is assumed that in a coordinate system at rest relative to the nozzle, there is an extension of the axial coherence distance. Michalke's assumption was utilized in the model which was developed to describe the effect of airspeed on free jet turbulence. The validity of the model could be experimentally confirmed on the basis of measurements of the cross-spectral density of the pressure fluctuations in the free jet. An indirect proof of its validity is provided by the agreement of the corresponding experimental values with the data calculated by means of a relation derived on the basis of the model. The agreement, which is very good, shows that there are no other noise sources in addition to the free jet. The absence of noise sources in the interior of the engine leaves no possibility to achieve a further reduction in aircraft-produced noise. G.R.

A81-47601 # Investigations of vortex formation on wings with cropped leading edges (Untersuchungen über die Wirbelbildung an Flügeln mit geknickten Vorderkanten). U. Brennenstuhl and D. Hummel (Braunschweig, Technische Universität, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-046*. 24 p. In German.

The aerodynamic characteristics of wings with cropped leading edges (double delta wings) are investigated. Measurements are made of the stress distribution and flow. Delta wings are found to produce flow with primary vortex accompanied by secondary separations of flow on each wing half. Streamlines are obtained with a marked secondary separation for wall streamlines on the suction side of the delta wing at an angle of incidence of 20 deg. Flow line development changes very little with inclinations of 20 deg, although a considerable change in flow develops at wing angles of 7.5 deg. At very large angles of incidence the two primary disturbances limit the maximum lift, and are found to originate from the wing tip and the cropping positions in the leading edges. Primary disturbances unite at growing angles of incidence, and produce changes in the stress distribution and aerodynamic parameters in the nonlinear incidence range. The investigation shows good correlation between calculations and measured results, which clarifies and quantifies the effects of turbulence on double delta wings. D.L.G.

A81-47603 # Damage recognition and localization by means of differential modal analysis (Schadenerkennung und Schadenortung mittels differentieller Modalanalyse). O. Bschorr and J. Mittmann (Messerschmitt-Bölkow-Blohm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-056*. 11 p. 7 refs. In German.

The considered procedure for the recognition of defects is based on the measurement of the resonant frequencies and modes. Such measurements can be conducted for a new aircraft. A defect leading to a weakening in strength produces a displacement in the frequency. The theory of differential modal analysis is derived for the general case of an arbitrary structure, taking into account a partition of the investigated structure into finite elements. The vibrational behavior of this model can be described with the aid of the mass matrix and the stiffness matrix. A one-defect procedure is discussed. The accuracy of the localization procedure is investigated by studying four specimens involving aluminum rods of a length of 500 mm. The obtained results could be experimentally confirmed. G.R.

A81-47604 # Contribution to the determination of the drag coefficient for air breathing flight vehicles on the basis of wind tunnel measurements (Beitrag zur Ermittlung des Widerstandsbeiwertes luftatmender Flugkörper aus Windkanalmessungen). D. Deppe and W. Schamel (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-036*. 19 p. In German.

The considered procedure for the determination of the drag

coefficient is illustrated with the aid of two specific flight vehicle projects, involving a typical subsonic flight vehicle with relatively large aspect ratio and a supersonic flight vehicle, using jet propulsion. The objective was in both cases, to provide a reliable prediction of the total drag value and, in addition, of the drag contributed by the individual flight vehicle components, taking into account body, wings, tail unit, and, in particular, the inlets. The principles of model drag evaluation are considered and an evaluation scheme is provided for each of the two flight vehicle projects. Evaluation results obtained for the supersonic flight vehicle are presented, taking into account a standard evaluation and alternative approaches. Attention is also given to the procedures which can be employed to derive the desired data for the flight vehicle itself on the basis of the results obtained with a small-scale model. G.R.

A81-47609 # Application of reduced natural longitudinal stability in the Airbus program (Anwendung reduzierter natürlicher Längsstabilität im Airbusprogramm). U. Graeber and B. Fischer (Messerschmitt-Bölkow-Blohm GmbH, Hamburg, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-062*. 18 p. In German.

Advantages of the reduced longitudinal stability for an aircraft are related to drag reduction and performance improvements. The most significant advantage in the case of an airliner is a saving in fuel. The reported investigation shows that the realization of reduced natural longitudinal stability in the case of an aircraft of the type of the Airbus is possible by introducing a tail-unit trimming-tank system. The utilization of such a system makes it possible to affect the location of the center of gravity. The advantages and the limitations of this approach are discussed. The approach is suited for an optimal adaptation of the position of the center of gravity to the requirements of the phase of flight. G.R.

A81-47612 # Onboard procedure for the measurement of wind shear gradients (Bordgebundenes Verfahren zur Messung von Scherwindgradienten). G. Neuwerth and R. Hartel (Aachen, Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-060*. 18 p. 7 refs. In German.

The occurrence of wind shears constitutes a considerable risk for an aircraft, particularly during the takeoff and landing phases. The risk factors for the aircraft are connected with changes in lift and disturbances regarding the moments relations. A description is presented of a simple measurement procedure for the determination of the wind shear gradient. The considered onboard procedure can be employed for objectives of flight control and for meteorological measurements. The procedure is based on the measurement of the difference of dynamic pressures at two points of the aircraft. Two pitot tubes with a certain vertical distance from each other are connected by means of a flexible rubber tube. The described procedure was tested with the aid of an aircraft. The measured data showed good agreement with values obtained by means of a measurement device located on the ground. G.R.

A81-47616 # A fail-operational duplex sensor concept for flight control systems on the basis of analytical redundancy (Ein fail-op Duplex-Sensorkonzept für Flugregelsysteme auf der Grundlage analytischer Redundanz). N. Stuckenberg (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-066*. 22 p. 7 refs. In German.

Based on a reliability concept of analytical redundancy, the fail-operational characteristics of a conventional triplex sensor configuration are determined by means of a duplex sensor configuration. Signals of instrument malfunction are generated by deterministic Luenberger observers. The operational efficiency of the reliability concept is determined as a function of the signal character of the instrument malfunction. As an example, the procedure is applied to the autopilot control system for the yawing motion of a HFB 320 commercial aircraft. The usefulness of this concept for a system of closed-loop design is shown to be questionable. Since no assumptions about the failure of the sensors or the signal character of an instrument malfunction can realistically be made, only those

malfunctions which had a slight effect on the recognition algorithm and simultaneously a comparatively great effect on the controlled system could be given. The theory of optimal control shows that a deterministic optimal failure signal exists for every system configuration of every sensor. The performance of the concept is then determined by this signal pattern. J.F.

A81-47620 # Ten years activity in the area of flight control for helicopters at night and in bad weather (Zehn Jahre Aktivität auf dem Gebiet der Flugführung von Hubschraubern bei Nacht und Schlechtwetter). E. Kohnen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugführung, Braunschweig, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-064*. 24 p. 5 refs. In German.

Various flight control systems were studied, taking into account simulated and real flight conditions. The subjects investigated are related to aspects of pilot acceptance, obtainable flight control performance, the pilot work load, and the performance provided by various sensors. The employment of visibility aids for the pilot is considered. Systems supplying such aids can enlarge the range of helicopter employment by providing the pilot, in case of insufficient natural visibility, with the possibilities for a flight under quasi-visibility conditions. The effect of a utilization of the novel systems on flight control performance and pilot work load was studied. Attention was given to the design of features of instrument and sensor indication display which are favorable from the viewpoint of human engineering. G.R.

A81-47621 # Computational fluid mechanics and its impact on the aircraft aerodynamicist. B. Hunt (British Aerospace Public, Ltd., Co., Aircraft Group, Preston, Lancs., England). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-003*. 45 p.

The capabilities of modern computer-based theoretical methods for predicting the basic types of aerodynamic flow are examined. It is shown that although the methods of computational fluid mechanics can never totally supplant all of the more traditional designer tools, they can offer substantial improvements in the design process, in the quality of the final product, and in the development time and costs. It is also noted that if the capabilities of modern computers are to be realized in the form of user-oriented programs, then careful consideration must be given to the environment for which these programs are to be developed. V.L.

A81-47622 # Vortex bursting on slender delta wings in transonic flow and its influence on missile aerodynamic characteristics. J. M. Muylaert (Dornier GmbH, Friedrichshafen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, Aachen, West Germany, May 11-14, 1981, Paper 81-047*. 35 p. 29 refs. Research supported by the Bundesministerium der Verteidigung.

The influence of compressibility effects on vortex breakdown is investigated for the case of sharp-edged delta wings. Normal force and pitching moment measurements were made at Mach numbers of 0.60-0.85 for delta wing aspect ratios of 1.26, 1.6 and 2.0, with incidence angles varying between near-zero to well above the critical angle at which lee-side vortex breakdown was observed. Detailed study of the lee-side pressure distribution of a wing with an aspect ratio of 2.0 showed that, at the critical angle, the vortex bursting point suddenly jumps from behind the trailing edge to the 50% chord position, giving rise to loss of lift and nose down pitching moment. Schlieren photography and sublimation tests confirm these conclusions, which are visualized by means of water tunnel tests. Attention is given the effect of these phenomena on delta-winged missiles. O.C.

A81-47725 # Prediction of range and endurance of jet aircraft at constant altitude. C. W. Bert (Oklahoma, University, Norman, OK). *Journal of Aircraft*, vol. 18, Oct. 1981, p. 890-892. 15 refs.

Jonas (1947) has reported an analysis of range for turbojet-powered aircraft. Ashkenas (1948) has obtained an expression for a jet-aircraft range at altitudes below 35,000 ft and a logarithmic form for the constant-temperature stratosphere. In the current study, it is shown that neither the square-root expression derived by Jonas nor

the logarithmic form are appropriate for constant-altitude cruise. The presented analysis removes two deficiencies in the earlier investigations and obtains a simple, closed-form expression which is more appropriate for constant-altitude cruise than either of the standard expressions of Jonas and Ashkenas. The closed-form equation is applied to an example problem. G.R.

A81-47785 High peak energy shaped-pulse electromagnetic crack detection. I. G. Hendrickson and K. A. Hansen (Boeing Co., Seattle, WA). In: *Eddy-current characterization of materials and structures; Proceedings of the Symposium, Gaithersburg, MD, September 5-7, 1979*. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 129-139.

A high peak energy, shaped-pulse, eddy current (SPEC) technique has been developed and investigated with the objective of improving crack detection of thick multiple-layer aircraft structures. The SPEC concept is reviewed, and it involves applying the high current level slow rise time or low-frequency portion of the shaped pulse to obtain the required depth-of-field penetration into the structure. The basic SPEC instrument is described: It is comprised of (1) a pulsar unit to produce the shaped current pulse, (2) a transmit or drive coil to generate the electromagnetic field to be injected into and collapsed out of the structure to be tested, and (3) a receive or pickup coil to detect the produced eddy currents/magnetic fields collapsing from within the structure and modified by cracks in the structure. Investigations include tests of variables, including base-metal conductivity, fastener variability, edge margin, interface gap, fastener height/countersink depth, upper-layer thickness, and probe lift-off. It is shown that crack-inspection capabilities of second-layer structures with 0.635 to 1.27-cm-thick upper layer skin have been improved significantly with the SPEC inspection system. K.S.

A81-47801 Test methods and design allowables for fibrous composites; *Proceedings of the Symposium, Dearborn, MI, October 2, 3, 1979*. Symposium sponsored by the American Society for Testing and Materials. Edited by C. C. Chamis (NASA, Lewis Research Center, Cleveland, OH). Philadelphia, PA, American Society for Testing and Materials (ASTM Special Technical Publication, No. 734), 1981. 442 p. \$44.

Papers are presented on special test methods for fibrous composites for quantifying design material properties. Studies are divided into four major areas: (1) new and special test methods, including those for transverse tensile strength, shear modulus, longitudinal compression, and impact resistance; (2) special test methods and analysis, including off-axes and angle-ply tension and compression, fracture and fatigue, and biaxial stress states; (3) design allowables, describing procedures for setting and selecting design allowables in general, and also for composite aircraft structures, graphite/polyimide bolted joints, cost-effective mechanical property characterization, statistical considerations, intraply hybrids, and compression and fatigue; (4) design allowables for special applications, describing procedures for buckling of cylindrical components, proof load of pressure vessels, strength of composite joints, and environmental effects and creep. The papers provide considerable information for test methods and for composite analysis of these methods, as well as tests and procedures for establishing design allowables. K.S.

A81-47811 Developing design allowables for composite helicopter structures. M. J. Rich and D. P. Maass (United Technologies Corp., Sikorsky Aircraft Div., Stratford, CT). In: *Test methods and design allowables for fibrous composites; Proceedings of the Symposium, Dearborn, MI, October 2, 3, 1979*. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 181-194. 13 refs.

A procedure is presented for developing static and fatigue design allowables for advanced composite materials used in aircraft structures. The allowables are established at the material lamina level accounting for environmental conditions such as moisture and elevated temperatures. Kevlar/epoxy and graphite/epoxy specimens are tested, and static and fatigue strength and the elastic constants are obtained for basic laminate orientations of a woven fabric and a unidirectional tape. Static test results are presented as a percentage of mean room temperature dry strength. It is shown that the

environmental effects are more pronounced for the matrix modes than for the fiber modes of the fracture, and that Kevlar/epoxy is more sensitive to the environmental design conditions than graphite/epoxy. A constant-life diagram, representing fatigue test results as a percentage of room temperature wet static tensile strength, shows that the tension-compression and compression-compression range may be the major aspect of fatigue design. It is also shown that the use of small sample sizes using a simple normal distribution seems to be sufficiently accurate to establish static design allowables. K.S.

A81-47813 **Cost-effective mechanical property characterization.** J. A. Suarez (Grumman Aerospace Corp., Structural Mechanics Section, Bethpage, NY). In: Test methods and design allowables for fibrous composites; Proceedings of the Symposium, Dearborn, MI, October 2, 3, 1979. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 208-228. Contract No. F33615-78-C-5234.

Current cost-effective mechanical property characterization methods are described for advanced composites in automotive and stiffness-critical aircraft secondary structures, using coupon-type specimens tailored to the special application at hand. The automotive application involves the testing of a roof spider and gullwing doors of a brushed stainless steel and reinforced-plastic sports car, while the aerospace application involves the establishment of material and process specifications, selection of a long-term moisture-absorption criterion, and coupon static tests to establish design values with environmental and vacuum-pressure-cure knockdown factors. Data presented include those for test tensile strength and modulus for vacuum-pressure cured graphite/epoxy laminates of various fiber orientations. The design values, given as ratios of dry strength at temperature of autoclave-cured laminates, are established and used in the design of a trailing-edge component. Among the conclusions presented are that abbreviated coupon testing for static design values for secondary structures can be applied to expand utilization of composite structures and rapid processing of composites for high production rates or minimum manufacturing costs can result in a reduction of compression strength. K.S.

A81-47842 **Hyperbolic origins.** C. Powell. *Journal of Navigation*, vol. 34, Sept. 1981, p. 424-436. 26 refs.

An historical account is given of antecedents of modern radio position-fixing systems whose position lines are of hyperbolic form. Consideration is given (1) synchronized sound signals, by which simultaneous transmissions from different points made possible the derivation of a position line by the differential timing of signal reception; (2) sound ranging, in which the position of enemy guns was determined through a comparison of the times at which its report reached a number of listening posts; (3) radio-acoustic trials, in which the acoustic element consisted of sea-bottom hydrophones near shore; (4) comparison of radio signal strength, by which a chain of transmitting stations would enable receiving ships to find their position; (5) ranging and position fixing, where two pairs of receiving stations in a crossed-baseline layout fixed the position of a transmitter-carrying ship; (6) Doppler-effect radio systems; (7) hyperbolic position-fixing for mobile receivers; (8) free-running transmissions; (9) frequency-modulation, for the resolution of hyperbolic pattern ambiguity; and finally (10) the GEE, LORAN and OM systems. O.C.

A81-47843 **The relation between aircraft fuel reserves and navigation.** V. W. Attwooll (Civil Aviation Authority, London, England). (*Royal Institute of Navigation, Meeting, London, England, Jan. 21, 1981.*) *Journal of Navigation*, vol. 34, Sept. 1981, p. 437-449; Discussion, p. 450, 451.

A rational basis is presented for the determination of fuel uplift quantities in commercial operations, in relation to safety and regularity of services. Numerical models are devised as aids in estimating such factors as the regularity of service to be expected from a given fuel quantity uplifted at take-off, assuming that in-flight decisions about fuel usage are made in a rigid, automatic way. Navigation figures as an important element because all in-flight decisions demand exact knowledge of aircraft position. Attention is given the possible effects on fuel uplift policies of various changes and developments in aircraft equipment and air traffic control (ATC) systems; for instance: (1) the use of blind landing equipment of high reliability can influence a pilot's decision to continue holding or

divert to an alternative landing site; and (2) airborne flight management systems are being developed to help the pilot implement fuel conservation through automatic estimates of the best speed and altitude to fly under given conditions, reducing fuel consumption by an estimated 1.6%. O.C.

A81-47844 **A simple radar for navigation accuracy measurements.** S. Nagaoka, E. Yoshioka, and P. T. Muto. *Journal of Navigation*, vol. 34, Sept. 1981, p. 462-469. 6 refs.

In order to survey height-keeping errors, a simple, height-finding radar, or Navigation Accuracy Measurement System (NAMS), has been developed. The radar, which is based on a curve-fitting method, consists of an antenna with fan-beam radiation pattern, a transceiver, a digitizer and a mini-computer; with the antenna rotating about a horizontal axis and scanning aircraft flying overhead. The height of detected aircraft is estimated by processing the data obtained over several scans. The height-measurement accuracy of NAMS depends upon the method of signal processing, the number of radar plots (depending on flight conditions), and the accuracy of input data. Results of a computer simulation of the system for the case of turbojet aircraft flying at altitudes of 30-40,000 feet are presented, in terms of lateral deviation in nm and estimated height measurement error. O.C.

A81-47888 **A practical probabilistic method for evaluating the fail-safeness of structures that may fail due to fatigue.** J. R. Gebman (Rand Corp., Engineering and Applied Sciences Dept., Santa Monica, CA) and P. C. Paris (Washington University, St. Louis, MO). In: Fatigue crack growth measurement and data analysis; Proceedings of the Symposium, Pittsburgh, PA, October 29, 30, 1979. Philadelphia, PA, American Society for Testing and Materials, 1981, p. 271-280. 9 refs.

The undetected propagation of a fatigue crack constitutes a significant cause of aircraft and other structural failures. To raise the structural failure load to a relatively high level, the manufacturer can divide the structure into many small elements, which significantly increases the ability of a structure to tolerate an element failure. This paper presents a procedure for calculating the probability that the structure has not failed, as the function of the crack propagation history for an undetected fatigue crack. The form of the procedure is so simple that computations with a desk calculator can yield reasonably accurate results. Moreover, the necessary input data are often readily available. By adopting such a procedure, aircraft manufacturers and operators can better identify those elements that pose the greatest threat to structural integrity. (Author)

A81-47957 # **Damping of turbomachine blade variations by subsonic flow.** G. S. Pisarenko, A. A. Kaminer, V. A. Balalaev, N. Ia. Nastenka, A. L. Stel'makh, and A. V. Dunaev. In: Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980. Zurich, Juris-Verlag, 1981, p. 151-161.

Experimental results are presented concerning aerodynamic damping for compressor blades in nonuniform subsonic flow with vortex wakes. The effects of stator and rotor spacing, maximum additional velocity in the wake, the orientation of the wake in relation to the profile chord, the regime parameters of the flow, and the geometrical parameters of the cascade were investigated. Results show that the nonuniformity of the flow which occurs in turbomachines has no influence on the aerodynamic damping. B.J.

A81-47959 # **Stability and flutter analysis of turbine blades at low speed.** T. J. Akai and H. Atassi (Notre Dame, University, Notre Dame, IN). In: Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980. Zurich, Juris-Verlag, 1981, p. 187-201. 9 refs. Contract No. F49620-76-C-0014.

An aeroelastic analysis for highly loaded turbine blades at low speed is carried out for various vibratory modes. These include pure bending and torsion as well as coupled oscillatory modes. The analysis is based on a complete aerodynamic theory which fully accounts for the blade geometry, flow conditions and cascade parameters. A damping coefficient simulating structural damping is also included. The results clearly show that classical flutter can occur for low speed turbine cascades at typical operating conditions. This is directly attributable to high blade loading and thickness. (Author)

A81-47961 # Numerical experiments on unsteady flows through vibrating cascades. M. Pandolfi. In: *Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980.* Zurich, Juris-Verlag, 1981, p. 211-228. 8 refs.

A numerical approach is presented for computing the inviscid compressible 2D unsteady flow in a vibrating cascade. The full Euler Equations are considered and no restrictive assumptions are required about geometry of the blading. The analysis is here confined to subsonic flows. The description of the modeling of the boundaries and the numerical methodology is given. Particular attention is paid to the explicit treatment of the wake behind the blade during the unsteady flow. Checks on the accuracy of the computations are done and comments are given on few numerical examples. (Author)

A81-47962 # Computer-aided investigation of turbomachine aerodynamics and aeroelasticity. S. M. Belotserkovskii, A. S. Vol'mir, V. V. Kuleshov, M. I. Nisht, G. U. Stepanov, and R. M. Fedorov. In: *Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980.* Zurich, Juris-Verlag, 1981, p. 229-249. 31 refs.

The paper examines aspects of the computer-aided solution of aeroelasticity problems in turbomachines by the synthesis of numerical methods of unsteady aerodynamics and elasticity. In particular, it is shown that in solving nonlinear aeroelasticity problems it is necessary to perform the step integration of nonlinear equations of aerodynamics and aeroelasticity. Aerodynamic loads and deformations for each step can be corrected by an iteration method. B.J.

A81-47963 # On the numerical analysis of stall flutter in turbine cascade. S. Takahara (Mitsubishi Heavy Industries, Ltd., Nagasaki, Japan), T. Adachi, and Y. Kadoya. In: *Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980.* Zurich, Juris-Verlag, 1981, p. 251-262. 7 refs.

The modified FLIC method using the triangular finite element mesh pattern was employed to solve the problem of unsteady stalled flow through a turbine cascade; the calculation was performed for the vibration of grouped blades without taking into account the interblade phase angle of vibration. Numerical results for low-pressure end blades of a steam turbine were compared with flutter test data on aerodynamic damping, and satisfactory agreement was obtained. It is concluded that this method is suitable for the prediction of the stall flutter characteristics of blade profiles. B.J.

A81-47966 # Stability analysis of the twin mode model of coupled flexion-torsion vibrations in aeroengine fans. R. A. J. Ford (New South Wales, University, Kensington, Australia). In: *Aeroelasticity in turbomachines; Proceedings of the Second International Symposium, Lausanne, Switzerland, September 8-12, 1980.* Zurich, Juris-Verlag, 1981, p. 297-308.

The twin mode representation of coupled flexion-torsion vibrations in aeroengine fans is essentially a linear feedback system in which flutter is represented by system instability. In earlier papers the model was analysed from direct physical considerations; in this paper the analysis is extended, amplified and unified by applying classical automatic control theory to the twin mode model. The results generally confirm the basic conclusions of the earlier analysis although they have also identified and clarified a number of detail misconceptions which had arisen in the previous work. (Author)

A81-47993 Damping applications for vibration control; Proceedings of the Winter Annual Meeting, Chicago, IL, November 16-21, 1980. Meeting sponsored by the American Society of Mechanical Engineers. Edited by P. J. Torvik (USAF, Institute of Technology, Wright-Patterson AFB, OH). New York, American Society of Mechanical Engineers (Applied Mechanics Symposia Series, AMD Volume 38), 1980. 163 p. S24.

Papers are presented on viscoelastic materials for damping applications, friction damping, damping applications in aero-propulsion systems, and the treatment of damping in transient computations. Attention is also given to the damping capacity of fiber reinforced composites, to the damping of panels due to ambient air, and to the application of damping for noise control in diesel engine components. C.R.

A81-47999 # Damping applications in aero-propulsion systems. J. P. Henderson (USAF, Materials Laboratory, Wright-Patterson AFB, OH). In: *Damping applications for vibration control; Proceedings of the Winter Annual Meeting, Chicago, IL, November 16-21, 1980.* New York, American Society of Mechanical Engineers, 1980, p. 145-158. 21 refs. AF Project 2418.

Several applications of vibration damping technology to high cycle fatigue problems in jet engine components are discussed. It is shown that constrained layer damping treatments, using polymeric materials, have provided cost effective solutions to many difficult high maintenance cost situations. On the other hand, engine experience with vitreous enamel coatings for the damping of hot engine components, although very promising, has pointed the need for further material development for increased durability. (Author)

A81-48003 Digital simulation for energy conservation in a large wind tunnel plant system. F. L. Shope (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, TN). In: *Annual Simulation Symposium, 13th, Tampa, FL, March 19-21, 1980, Record of Proceedings.* Tampa, FL, Annual Simulation Symposium, 1980, p. 73-86. 12 refs.

This paper documents a feasibility study of mathematically modeling the wind tunnel complex and associated plant in the von Karman Gas Dynamics Facility at the Air Force's Arnold Engineering Development Center in Tennessee. The ultimate goal of the modeling effort is to effect energy conservation measures by modifying operational procedures and plant hardware. A general theory is proposed to model the aerodynamics and losses of each plant or tunnel component in terms of a set of 33 equations based on one-dimensional, unsteady, nonisentropic flow and admitting arbitrary interconnections between components. A computer program is currently under development to apply the theoretical model using the IBM Continuous System Modeling Program III. In conjunction with the modeling effort, an assessment was made of the existing experimental data base which could be used to drive the mathematical model. Requirements for experimental data are discussed in general terms. (Author)

A81-48009 Simulation model to evaluate maintenance strategies for large network of fielded systems. G. A. Wong (Mitre Corp., McLean, VA). In: *Annual Simulation Symposium, 13th, Tampa, FL, March 19-21, 1980, Record of Proceedings.* Tampa, FL, Annual Simulation Symposium, 1980, p. 311-326. U.S. Department of Transportation Contract No. FA80WA-4370.

A dynamic simulation model of a field maintenance organization has been developed and validated. The objective of the model is to provide an analytical tool for evaluating the operational feasibility of new maintenance strategies prior to their introduction into the field. This simulation model is an accurate replica of the policies and time critical maintenance activities within a field organization, providing a rendering in detail of each technician and each facility as events take place in time. This paper discusses the structure of the model, the functions simulated, the validation experiment, and an application of the model. (Author)

A81-48062 # New developments in compact plate-fin heat exchangers. K. O. Parker and M. G. Coombs (AiResearch Manufacturing Company of California, Torrance, CA). In: *Compact heat exchangers - History, technological advancement and mechanical design problems; Proceedings of the Twenty-fourth Annual International Gas Turbine Conference and First Solar Energy Conference, San Diego, CA, March 11-15, 1979.* Conferences sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers (Heat Transfer Symposia Series, HTD Volume 10), 1980, p. 171-179.

The extension of compact plate-fin heat exchanger capabilities in order to accommodate the performance requirements of regeneratively cooled hypersonic ramjet engines, laser weapons, aircraft engine infrared suppressors, and large high-efficiency gas turbine cycles is described. Attention is given to cooling fluid flow path geometry and heat exchanger fabrication techniques, such novel materials as alumina and silicon carbide, and space and weight constraints imposed on designs by airborne application. It is shown that operating temperatures, pressures and area densities have been significantly increased. O.C.

A81-48064 Fly-by-wire Jaguar. G. Warwick. *Flight International*, vol. 120, Sept. 12, 1981, p. 816-818.

A status report is given for the fly-by-wire Jaguar fighter test bed, which is equipped with a full-time, quadruplex digital flight control system offering a theoretical mean time between catastrophic failures of 250 million hours. General consideration is given the advantages of fly-by-wire and electronic flight control systems (such as relaxed stability and stability simulation, respectively), and parallel developments for the Mirage 2000 and MBB F-104 and Advanced Fighter Technology Integration F-16 research aircraft, are cited. Attention is given to the digital management of pilot maneuver demand inputs by the flight computer, the integration of sensor signals, fail-safe reliability of all system elements, pre-flight testing of input tolerances, and software development. Future avenues for design development of such systems and their application to advanced fighters are also discussed. O.C.

A81-48067 F-100s set to become target drones. D. M. North. *Aviation Week and Space Technology*, vol. 115, Sept. 28, 1981, p. 69-71.

The Military Aircraft Storage and Disposition Center has undertaken the conversion of about 300 stored F-100s into QF-100 target drones. An account is given of the techniques by which retired military aircraft are conditioned for storage, so that hydraulic, fuel, electrical and electronic systems may be rapidly brought to operating condition and all structures are protected from fatigue and corrosion. It is noted that the facility's location at Tucson, AZ, affords it the low rainfall, 10-20% humidity, and alkaline soil needed to minimize deterioration. Other aircraft in storage, such as A-4s that have been sold to Malaysia for active manned service, are also stored for eventual refurbishment by private companies. Other aircraft similarly processed have been F-102s, A-7s and F-8s. O.C.

A81-48079 Droplet breakup regimes and criteria for their existence. A. A. Borisov, B. E. Gel'fand, M. S. Natanzon, and O. M. Kossov (Akademii Nauk SSSR, Institut Khimicheskoi Fiziki, Moscow, USSR). (*Inzhenerno-Fizicheskii Zhurnal*, vol. 40, Jan. 1981, p. 64-70.) *Journal of Engineering Physics*, vol. 40, no. 1, July 1981, p. 44-49. 31 refs. Translation.

Experimental and theoretical work on droplet breakup by a gas flow in shock tubes and nozzles is reviewed. By analyzing experimental results, three droplet breakup regimes are identified: (1) droplet breakup of the parachute type, (2) droplet breakup with tearing off of the surface layer, and (3) explosive breakup of droplets. Conditions for the favored development of one or the other droplet breakup regimes are briefly discussed. V.L.

A81-48097 # Calculation of natural vibrations for thin-walled irregular reinforced shells of the helicopter fuselage type using the finite-element work method (Raschet na sobstvennyye kolebaniia tonkostennyykh nereguliarnykh podkreplennykh obolochek tipa fiuzeliyazha vertoletov konechno-elementnym metodom sil). F. F. Baizaitov and Z. I. Burman. *Akademii Nauk SSSR, Izvestiya, Mekhanika Tverdogo Tela*, July-Aug. 1981, p. 149-159. 12 refs. In Russian.

An equation describing the natural vibrations of a fuselage is obtained in terms of the work method using a three-dimensional Green's function, and a transformation leading to an equation based on the method of displacements is given. A method is proposed for reducing the order of the dynamic matrix. It is shown that the natural frequencies obtained using a reduced-order matrix are in good agreement with frequencies obtained with a higher-order dynamic matrix. V.L.

A81-48120 The role of the earth's shape in navigation - An example. W. Kuebler and S. Sommers (Hydrotronics, Inc., McLean, VA). *Navigation*, vol. 28, Spring 1981, p. 29-33. 7 refs.

The accuracy of navigational fixes obtainable with present day navigation systems is such that the earth's geodesy must be considered, especially in comparing relative fixes. Approximations to the exact transformations between geodetic and geocentric coordinates can be made so as to optimize computer times. This paper presents the results of a systematic error analysis of these approximations to the exact coordinate transformations and the resulting real-time and core requirements on an AN/UUK-20 standard Navy mini-computer. (Author)

A81-48121 An analytical solution of the two star sight problem of celestial navigation. J. A. Van Allen. *Navigation*, vol. 28, Spring 1981, p. 40-43. Navy-supported research.

The classical problem of celestial navigation, in its simplest form, is the determination of an observer's longitude and latitude from the altitudes of two identified stars, observed at a known Greenwich Mean Time on a known date. A novel solution of this problem in closed analytical form is given herein. The solution yields the two possible positions of the observer without any prior knowledge of his position, without any dependence on tables of computed altitudes and azimuths for an assumed position, and without any graphical work. The basic two-fold ambiguity is resolved to yield a single, unique position by repeating the calculation using the altitudes of a third star and of one of the two previous stars. The full analytical solution is given as are some artificial numerical examples, readily performed on a hand-held, programmable calculator. (Author)

A81-48142 Sliding-seal electron beam slot welding of an aircraft wing closure beam. R. W. Messler, Jr. (Eutectic Corp., Flushing, NY). *Welding Journal*, vol. 60, Sept. 1981, p. 31-39.

A technique was developed for eliminating the seal wear associated with sliding-seal electron beam (EB) welding. This method, referred to as slot welding, involves the use of a cover plate that seals statically to the sliding seal welding head; the cover plate is sealed with an O-ring to a slotted chamber cover plate. By welding through the hole-and-slot arrangement between the sealing plate and a small movable vacuum chamber, the inherent advantages of EB welding can be combined with the rapid pump-down, low capital equipment cost, and the portability of the technique. Five tapered channel Ti-6Al-6V-2Sn wing closure beams for the F-14A were sliding-seal EB welded to demonstrate the system. The first four beams were welded using a partial penetration locking pass, followed by a full penetration locking pass at 30 kV/50 mA, 6.20 A, and 30 ipm; the fifth beam was welded without the partial penetration locking pass. The resulting welds were all uniform and fairly clean, but porosity was reduced in the fifth beam by elimination of the locking pass. The tensile, fracture toughness, and fatigue properties of the welded specimens were compared to those of the base metal and showed good results. J.F.

A81-48196 # Analysis of the operation of air turborefrigeration plants and their use for on-the-ground air-conditioning of aircraft (Analiz rabochego protessa vozdukhnykh turbokholodil'nykh ustanovok /VTKhU/ i ikh primeneniye dlia nazemnogo konditsionirovaniia vozdukh na samoletakh). E. Pasztor (Budapesti Muszaki Egyetem, Budapest, Hungary). *Periodica Polytechnica, Transportation Engineering*, vol. 9, no. 1, 1981, p. 37-47. 7 refs. In Russian.

The theory and operation of turborefrigeration plants which use air as refrigerant are examined. Consideration is given to the effects of losses in the various turborefrigerator components on the specific cooling power. It is shown that there exists an optimum value of the specific cooling power which depends on the pressure ratio. Applications of turborefrigerators are discussed with particular reference to on-the-ground air-conditioning of aircraft. V.L.

A81-48328 The array processor - A real-time simulator. M. E. Sturgeon (Floating Point Systems, Inc., Beaverton, OR). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 12-14.

The technique of parallel processing with an array processor is described; overviews are presented of architecture, functional components, software, and simulation applications (sea state simulation, aircraft simulation, and road simulation). The architecture features parallelism and pipelining in both the hardware and software. The floating-point arithmetic hardware provides fast high-precision calculations. The input/output interfaces provide access to the outside world via a variety of peripheral devices. A general-purpose computer with a host with a parallel processor offers an attractive alternative to the large mainframe or wholly analog system. B.J.

A81-48329 Function generation techniques. H. R. Justice (Computer Sciences Corp., Defense Systems Div., Huntsville, AL). In: Summer Computer Simulation Conference, Seattle, WA, August

25-27, 1980, Proceedings.
Press, 1980, p. 15, 16.

Arlington, VA, AFIPS

Available methods of function generation in real-time hybrid simulations are reviewed. A particular technique that was used on a real-time hybrid simulation of a Simplified Inertial Guidance-Demonstration (SIG-D) in the Advanced Simulation Center at Redstone, Alabama is presented in detail. It is shown that the Multi-Variable Function Generator (MVFG) developed by Electronic Associates provides an attractive alternative to the other available methods of function generation in a hybrid simulation. Because of the large bandwidth of the MVFG, multiplexing techniques can be used to expand the number of functions obtainable from the available MVFG units. The multiplexing scheme presented herein provides a reliable method of expanding the function generation capacity in any hybrid facility that contains function generators with similar characteristics to the MVFG. B.J.

A81-48333 A technique for the implementation of non-linear models as real-time digital simulations. P. McLaughlin (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 111-115. 12 refs.

This paper presents a technique that can be utilized to perform real-time simulation tasks using digital computers. For certain types of nonlinear models, the computational stability of simulations employing this technique will be more attractive than that obtained from alternative approaches. This, in turn, allows the use of more complex models or, conversely, less expensive computers in these tasks. The technique is based on an implicit method used at the Pratt and Whitney Aircraft Group to simulate the steady-state and transient operation of turbine engines and their components. The manner in which the technique is implemented for a general nonlinear model is described. The stability and accuracy of the technique is compared to other methods used for real-time simulation. A discussion of modifications appropriate to programs employing integer arithmetic is included. (Author)

A81-48351 Numerical simulation of hydrodynamic ram. K. D. Kimsey (U.S. Army, Ballistics Research Laboratory, Aberdeen Proving Ground, MD). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 299-301. 8 refs.

The paper presents the results of a numerical simulation of a kinetic energy projectile with an L/D ratio of 3 impacting at normal obliquity a fuel cell simulator. The simulation has been performed using the two-dimensional EPIC-2 (Elastic-Plastic Impact Computation in 2 Dimensions) code. The technique is based on a Lagrangian formulation where the equations of motion are integrated directly, rather than through the traditional stiffness matrix approach. The analysis has confirmed that the entrance panel petaling results from the fluid impulsively accelerating the entrance panel. The hydrostatic pressures generated in the fluid initiate bulging of the exit panel prior to perforation by the penetrator. V.L.

A81-48358 The evolution of real-time digital simulation of aircraft for training applications. G. V. Amico and C. E. Lindahl (U.S. Navy, Naval Training Equipment Center, Orlando, FL). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 365-370. 15 refs.

The evolution of real-time digital simulation for flight trainers is reviewed with emphasis on computer system architecture, iteration rates, and programming. With respect to computer architecture, the trend has been one of going from expensive CPU's to the present system architecture of inexpensive and powerful distributed processors based on a functional allocation to the subsystems involved in the flight trainers. Iteration rates are expected to be influenced by on-board computers whose iteration rates may exceed the current 30 Hz standard. Progress is also expected in the use of FORTRAN as more efficient compilers are developed by computer manufacturers for real-time simulation. V.L.

A81-48359 Probe protection in camera/model visual systems. P. J. Bellocchio and R. B. Mallinson (Singer Co., Link Flight Simulation Div., Binghamton, NY). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings.

Arlington, VA, AFIPS Press, 1980, p. 371-374.
Contract No. N61339-76-C-0086.

A system has been developed for protecting the optical probe from collision with the modelboard during low altitude flight simulation in helicopter training simulators. The system uses a solid state infrared laser as a probe height sensor and an auxiliary impact sensor for additional protection around the probe tip. The probe protection software makes use of the probe height sensor output to make a decision as to whether a crash is imminent, and if necessary, issues a command for an emergency retraction of the probe. V.L.

A81-48368 Simulation of Microwave Landing System. J. K. Hsiao (U.S. Navy, Naval Research Laboratory, Washington, DC). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 542-546.

The FAA Microwave Landing System (MLS) uses a Time Reference Scanning Beam configuration. The ground installation uses two linear electronically scanned antenna arrays, scanning in azimuth and elevation directions. Radiating signals from the arrays in the 'TO' and 'FRO' directions received by a landing aircraft can be used to determine accurately the aircraft's angular position in both azimuth and elevation. The accuracy of the angle measurement depends on the beam steering algorithm, array component tolerances, multipath effects, failures in the array, and other associated problems. A computer simulation has been developed which represents the performance of the various phased array antenna systems which are being considered for use in the Microwave Landing System. The purpose of this simulation is to assess the angular accuracy of MLS in terms of its design parameters, tolerance effects, component and subsystem failures, multipath, and angle detection algorithm. The entire angle-measurement process used in MLS is modeled, including the phased array antenna, the beam steering algorithm, multipath propagation, and the airborne receiver and angle processor. (Author)

A81-48369 * Time delays in flight simulator visual displays. D. F. Crane (NASA, Ames Research Center, Moffett Field, CA). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 552-557. 13 refs.

It is pointed out that the effects of delays of less than 100 msec in visual displays on pilot dynamic response and system performance are of particular interest at this time because improvements in the latest computer-generated imagery (CGI) systems are expected to reduce CGI displays delays to this range. Attention is given to data which quantify the effects of display delays in the range of 0-100 msec on system stability and performance, and pilot dynamic response for a particular choice of aircraft dynamics, display, controller, and task. The conventional control system design methods are reviewed, the pilot response data presented, and data for long delays, all suggest lead filter compensation of display delay. Pilot-aircraft system crossover frequency information guides compensation filter specification. G.R.

A81-48371 Application of optimal control and estimation to autopilot and autothrottle systems. P. D. Daniels and D. Gangsaas (Boeing Commercial Airplane Co., Seattle, WA). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 562-565.

Methods for improving autopilot and autothrottle designs are discussed. Particular attention is given to reducing speed and path deviations and control surface activity in the presence of gust wind shear disturbances during the climb, cruise, and descent phases of flight. Linear quadratic regulator synthesis is used for the design of optimal full state feedback controllers. Kalman filters are designed for optimal estimation of airplane and wind states, and computer simulations are used for evaluation of various control designs. V.L.

A81-48373 Optimization of simulation models for avionics software verification. S. L. Benning (USAF, Avionics Laboratory, Wright-Patterson AFB, OH) and A. C. Brewer (Systems Consultants, Inc., Dayton, OH). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 570-573. 5 refs. Contract No. F33615-79-C-1739.

Various optimization techniques applied to maintain a cost-effective simulation system are investigated for the reorganization of the DAIS models simulation system. Present model requirements are discussed, and methods of optimizing are presented, including system analysis, priority matrix, SET/USE program, standard comment header, COMMON standard, structured FORTRAN, and word processing. Three phases of testing are used to verify the enhanced performance of the models, including stand-alone testing, integration and functional testing, and system testing. Any anomalies are detected, corrected, and verified to confirm proper operation. Results demonstrate an exceptionally effective methodology with widespread applications, producing faster and better structured models which are more readily maintained and transported. D.L.G.

A81-48376 Development considerations for real-time aircraft/avionic distributed computer control systems. R. D. Hawkins (U.S. Naval Air Systems Command, Washington, DC). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 586-589.

Concepts in real-time aircraft/avionic distributed computer control systems are investigated in an effort to produce a superior avionic product. NATO's efforts to establish an architecture oriented avionics technology are discussed, and the objectives of the Tactical Air Combat Technology Integration and Coordination System (TACTICS) are presented, including a continuity in the design process as a result of close interaction between all major elements of the computer system. The objectives of the systems software simulation laboratory and the real-time simulation laboratory are also presented, including the synthesis and formulation of tactical air combat avionics suites and the physical validation of actual hardware. Needs of the TACTICS facility such as the development of structured methodology to perform the synthesis functions are explained, and the solution is found in the structured design approach which requires the partitioning of the system functions into isolated modules. D.L.G.

A81-48379 Engine requirements for the T-37 trainer aircraft - A simulation study and analysis. T. D. Clark, Jr., L. W. Emmelhainz, and M. A. Martinez (USAF, Institute of Technology, Wright-Patterson AFB, OH). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 660-662.

The Air Force requires an operational inventory of aircraft engines to maintain the flow of T-37 aircraft used in basic pilot-training programs. This paper reports the results of a study of the system for acquiring and managing engines and components to support the flying training program. A network model was constructed and tested, and a number of experiments conducted to address key issues and problems in the system. The model is programmed using the Q-GERT simulation language. It focuses on the engine service required to support given levels of flying activity. Inventory levels at distributed points in the system are investigated and policies for placement recommended. The structure of the repair system is focused upon and various alternatives for its design are investigated. (Author)

A81-48380 Determination of cargo container inventories through logistics simulation. D. H. Cone (Boeing Computer Services Co., Seattle, WA). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 714-718.

A Container Movement Logistics Model was designed to evaluate the air shipment of cargo containers within a network of airport pairs. The simulation described in the paper was designed to determine the number of cargo containers required for a known level of air shipments, but the technique may be applied to surface transportation modes including rail, truck, and ship. (Author)

A81-48385 Transient vibrations of elastic panels due to the impact of shock waves. J. R. Coleby and J. Mazumdar (Adelaide, University, Adelaide, Australia). *Journal of Sound and Vibration*, vol. 77, Aug. 22, 1981, p. 481-494. 14 refs.

The dynamic response of elastic panels subjected to pressure loadings by shock waves is investigated. Accurate approximate

solutions for the time-history response (displacement and strain) of both a completely clamped panel and a simply supported panel are obtained. The transient behavior is discussed by using the isoamplitude contour lines method in conjunction with the normal mode method. The derived analyses are shown to be applicable in estimations of window, wall panel, or flat roof response to sonic boom or explosion blast waves. Illustrative examples are given for the response of an undamped skew panel and for an undamped triangular panel. Results, given in graphic form, are in good agreement with those obtained in previous investigations. J.F.

A81-48390 Finite strip analysis of singly curved skin-stringer structures. M. Petyt and C. C. Fleischer (Southampton, University, Southampton, England). *Journal of Sound and Vibration*, vol. 77, Aug. 22, 1981, p. 561-571. 17 refs. Research supported by the Ministry of Defence (Procurement Executive).

It is shown that the finite strip method can accurately predict the natural frequencies and modes of vibration of singly curved, skin-stringer arrays. The elements analyzed included a rectangular, singly curved, finite strip shell element and a new, compatible thin walled, open section beam element. Convergence studies for freely supported and clamped singly curved, rectangular shells show that only a few strips need to be used to obtain good accuracy. Both five bay and 15 bay skin-stringer structures were analyzed; the five bay structure analysis produced results similar to those of the transfer matrix method; the frequencies and mode shapes obtained in an analysis of the 15 bay structure also agreed closely with experimental measurements. J.F.

A81-48395 * Trailing edge noise prediction from measured surface pressures. T. F. Brooks (NASA, Langley Research Center, Hampton, VA) and T. H. Hodgson (North Carolina State University, Raleigh, NC). *Journal of Sound and Vibration*, vol. 78, Sept. 8, 1981, p. 69-117. 35 refs. Grant No. NSG-1377.

Trailing edge (TE) noise is investigated for the case of a two-dimensional airfoil embedded in a uniform low Mach number flow, and the usefulness of several TE noise theories is examined by applying them to the measured data. The TE noise spectra and directivity are quantitatively determined for the case of a high Reynolds number and a fully turbulent boundary layer. Parameters include angle of attack, flow velocity and TE bluntness. Evanescent wave theories by Chase (1975) and Chandiramani (1974) are compared to the present results and show good agreement. Agreement of the near field pressure scatter phenomenon analysis with measurements implies that the basic assumptions used in the analysis are correct, i.e., the turbulent boundary layer (TBL) flow passes the trailing edge into the wake region. No hydrodynamic wake shedding activity is confirmed for the two-sided TBL flow, and a method incorporating the principles of the coherent output power method is used to determine the sound field. The near field edge scatter model is found to not only establish optimum sizing of edge treatment for noise control, but also to separate and identify the scattered field from the incident hydrodynamic field. D.L.G.

A81-48401 # Operational characteristics comparison /ACV and SES/. F. W. Wilson and P. R. Viars (U.S. Naval Material Command, David W. Taylor Naval Ship Research and Development Center, Bethesda, MD). *American Institute of Aeronautics and Astronautics, Marine Systems Conference, 6th, Seattle, WA, Sept. 14-16, 1981, Paper 81-2064*. 12 p. 8 refs.

The performance of a fully skirted air cushion vehicle (ACV) relative to a sidehull air cushion vehicle or to a surface effect ship is evaluated by comparing the estimated total drag and power of the two vehicle types. The craft are compared on the basis of equivalent displacement, length-to-beam (L/B) ratio, loading, and speed. Drag estimation techniques, developed under the Amphibious Assault Landing Craft project for the ACV predictions and under the Surface Effect Ship project for the SES predictions, are used in the evaluation. The parameter ranges covered in the study were speed (30 to 70 knots), displacement (100 to 10,000 long tons), and loading (1.0 and 3.0 lb/ft). Results indicate that each craft type has distinct operational ranges where it has a powering advantage over the other craft. (Author)

A81-48416 # A new approach to weapon separation aerodynamics. F. A. Tessitore, A. Cenko, R. C. Meyer (Grumman

Aerospace Corp., Bethpage, NY), R. D. Dyer, and J. D. Waskiewicz (USAF, Wright Aeronautical Laboratories, Wright-Patterson AFB, OH). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1654*. 8 p. 8 refs.

An innovative approach has been developed for predicting the aerodynamic forces and moments acting on a store during separation from a parent aircraft. The method utilizes data obtained for one store in the flowfield to predict the forces and moments of another store in the same flowfield by identifying the local angle-of-attack distribution in proximity to the parent aircraft. Extensive comparisons between theory and test are shown for two different parent models, each with two different stores (four stores in all) at supersonic speeds, indicating the excellent correlation achieved. The potential for substantial wind tunnel cost savings is identified.

(Author)

A81-48417 # Determination of thrust and throttle-dependent drag for fighter aircraft. B. L. Hunt and N. S. Gowadia (Northrop Corp., Aircraft Div., Hawthorne, CA). *American Institute of Aeronautics and Astronautics, Aircraft Systems and Technology Conference, Dayton, OH, Aug. 11-13, 1981, Paper 81-1692*. 15 p. 13 refs.

This paper reviews the problem of determining the thrust and throttle-dependent drag of fighter aircraft. The flight conditions for which throttle-dependent drag is important are identified. Means of determining throttle-dependent drag are discussed with particular emphasis on wind tunnel techniques and the incorporation of the results into the overall drag build-up of the aircraft. Procedures are described for determining thrust and drag from flight test data. Finally, the impact of advanced concepts, such as thrust vectoring, thrust reversing and highly integrated concepts, on propulsion testing is discussed.

(Author)

A81-48479 Measured pressure distributions and shock shapes on a simple delta wing. L. C. Squire (Cambridge University, Cambridge, England). *Aeronautical Quarterly*, vol. 32, Aug. 1981, p. 188-198.

This note presents the results of an experimental investigation of the flow over a simple delta wing designed for a Mach number of 3.5. Complete pressure distributions were measured for incidences of 0 deg, 10 deg and 20 deg at Mach numbers of 2.5 and 3.5. A number of schlieren photographs of the shock system around the wing were obtained at the same conditions, and surface streamline patterns were studied at $M = 3.5$. The measurements were made to support numerical calculations which use this wing as a test case. (Author)

A81-48480 Evaluation of two-dimensional subsonic oscillatory airforce coefficients and loading distributions. D. J. Salmond (Royal Aircraft Establishment, Farnborough, Hants., England). *Aeronautical Quarterly*, vol. 32, Aug. 1981, p. 199-211. 9 refs.

A method is described for calculating numerically the aerodynamic stiffness and damping coefficients and loading distributions for a two-dimensional thin aerofoil oscillating harmonically in subsonic flow, from the Possio Integral Equation by approximating the loading by a finite series of basis functions. Sample loading distributions obtained by using the method are presented for a Mach number of 0.9 and a frequency parameter of 0.4. (Author)

A81-48544 Adaptive features and measurement requirements for advanced surveillance radars. B. H. Browne, Jr., L. Ekchian, and L. J. Lawdermilt (Sperry Corp., Clearwater, FL). In: *EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record*.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 190-194. 10 refs. Contract No. F30602-79-C-0152.

The measurement accuracy requirements for several classes of tactical air control problems are discussed, and adaptive approaches to beam scheduling and tracking are presented that exploit the agile beam capabilities of the radar to jointly meet both search and track requirements over a wide range of tactical situations. It is found that adaptive features are required in future agile-beam surveillance radars, including adaptive beam scheduling, adaptive waveform selection, adaptive tracking filters, and tracking filter selection. It is noted that in future agile-beam surveillance radars it will be

expedient to employ algorithms that adaptively select tracking filters matched to the assessed tracking difficulty and available processing power. C.R.

A81-48547 COMLINK - A communications/EW analytical and modeling tool. R. K. Keenan (Keenan Corp., Vienna, VA). In: *EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record*. New York, Institute of Electrical and Electronics Engineers, 1980, p. 244-252. 10 refs.

COMLINK is defined as a user-interactive microcomputer-based system designed to provide an objective basis for rapid and accurate analyses and modeling of communications scenarios involving three-dimensional dynamic tactical and strategic geometries, with or without jammer. The analytical approach to the conditions of no spectrum spreading, frequency hopping, direct spread spectrum, and hybrid Blue modes (the modulation being QPSK or BPSK or FSK or SQPSK) and follower or barrage or no jammer are discussed. Numerical results are given for an example tactical problem (16 kbit QPSK voice, follower jammer). The purpose is to record the insights of a certain group of engineers on how to deal with the 'dB bookkeeping' problem when the computational tedium index is stressed in the analysis of modern spread-spectrum communications systems. C.R.

A81-48558 # Availability requirements of the future ATC system. A. G. Zellweger (FAA, Washington, DC). In: *EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record*.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 400-405.

The functional evolution of ATC computer availability requirements is reported with emphasis on fault tolerance and system backup to establish the evolving requirements for availability. ATC is characterized in terms of a closed loop theory model consisting of functional elements such as a data managing function and a system function which executes control actions and is subject to disturbances such as weather and equipment outages. The ATC system of the 1980's and beyond the 1990's is discussed, and improvements are proposed, including increasing the number of control processes automatically performed, and entering new and revised data at all operational positions. Present and future fault tolerance requirements are also discussed, and improvements in error detection and isolation are suggested, which require greater software correctness through proofs of critical modules. Safety is the overriding concern, and a quantitative increase in confidence in system safety is sought. D.L.G.

A81-48559 * Reliability validation of systems for life-critical applications. K. S. Trivedi (Duke University, Durham, NC), J. W. Gault (North Carolina State University, Raleigh, NC), and J. B. Clary (Research Triangle Institute, Research Triangle Park, NC). In: *EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record*.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 406-409. 7 refs. Contract No. NAS1-15833.

A framework is proposed which addresses traditional reliability validation approaches consisting of life testing techniques which are inapplicable for digital flight control systems. A specific validation methodology is identified based on logical proofs, analytical modeling, and experimental testing. Research activities required to support continued development of validation technology are identified, and the validation procedure is driven by the reliability model obtained from the system description. The analytical reliability model is shown to be a proper abstraction of the system under consideration, and a proof of correctness of system design and system scheduler performance is proposed. D.L.G.

A81-48566 Infrared airborne radar. R. C. Harney (MIT, Lexington, MA). In: *EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record*.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 462-471. 12 refs. USAF-sponsored research.

A program aimed at developing and demonstrating the technology necessary for the construction of infrared radars for tactical

airborne applications is briefly reviewed. Infrared radar and conventional radar are compared, the comparison showing that infrared radar is a direct extension of the conventional radar principles to infrared wavelengths. A testbed radar system for measuring imaging properties, weather penetration, and moving target indication is described, and it is stated that tactical airborne applications will require radar systems much more powerful and complex than the testbed radar. A transportable measurements radar, scaled up to parameter values useful in tactical scenarios, and examples of its initial performance are presented. Component technology unique to infrared radars is emphasized, and component developments pertinent to the transportable system are discussed. K.S.

A81-48602 # Ray-theory predictions of the sound radiated from realistic engine intakes. A. J. Kempton and M. G. Smith (Rolls-Royce, Ltd., Derby, England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1982.* 8 p. 6 refs.

Ray theory is used to calculate the propagation, attenuation, and radiation of broadband fan-noise for realistic engine-intake configurations. The theory is compared with the mode theory for an infinite hyperboloidal duct, showing excellent agreement at the given frequencies, except close to the duct wall; this discrepancy is due to the neglect of diffraction in the ray theory approach outside the shadow region in calculating the radiation of high-frequency sound from a smooth engine intake. Bellmouth intakes had a large effect on the directivity of both the radiated sound and the insertion loss. The sound-pressure-level (SPL) insertion loss at one angle in the far field was more dependent on the source type for ducts fitted with bellmouth intakes than for flanged cylindrical ducts. The effect on the radiated sound of complex intake flows was of the order of the flow Mach number if the flow was rotational, but only of the order of the Mach number squared if the flow was irrotational. A new method of choosing intake liners to optimize the EPNL reduction is described; this method is based on the theory that the SPL insertion loss at typical fan-noise frequencies is largely independent of the source frequency, and depends principally on the liner impedance, liner length, and engine geometry. J.F.

A81-48606 # An acoustic source modelling technique to predict the near sound field of axisymmetric turbulent jets. C. V. Sundaram and J. R. Maus (Tennessee, University, Tullahoma, TN). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2022.* 10 p. 9 refs. Contract No. F40600-77-C-0009.

According to the considered technique, the source for each one third octave frequency is modelled by a combination of uncorrelated elementary sources derived from a multipole expansion. The strengths of the various source components at a particular frequency are determined by a constrained least squares fit to the far field directivity pattern. When the effects of the source motion and axial source distribution with frequency are taken into account, the computed sound field agrees reasonably well with data obtained in the near field. Computations at higher frequencies (roughly, above 1000 Hz) indicated that the dependence of the predicted near sound pressure levels on the order of terms considered from multipole expansion series decreases as the frequency under consideration increases. G.R.

A81-48607 * # The role of the helical jet mode in aerodynamic noise generation. J. C. Hardin (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, VA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1963.* 10 p. 38 refs.

The helical jet mode is modeled by an infinite helical vortex filament, and an exact analytical solution for the induced velocity field interior to the filament is derived. These expressions are then used to model the jet flow field and to analyze the high subsonic and supersonic jet noise generation. It is shown that noise will be generated directly if the helical mode convects or rotates. Reducing this noise by stabilizing the mode is difficult, since the self-induced velocities of the mode itself cause it to convect and rotate; the use of noncircular nozzles is suggested to eliminate the symmetry of the boundary condition. The helical mode can also generate noise indirectly by inducing time-dependent Coriolis accelerations on small-scale turbulence propagating in its induced velocity field. This

suggests that any upstream turbulence generation has an enhanced potential for noise propagation when propagating in the presence of the helical mode. J.F.

A81-48608 # Procedure for evaluation of engine isolators for reduced structure-borne interior noise transmission. J. F. Unruh (Southwest Research Institute, San Antonio, TX). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1970.* 12 p. 10 refs.

A structure-borne interior noise transmission model of a test aircraft was developed, based on analytical models of the simulated engine, vibration isolators, and engine mount structure coupled to an empirical model of the fuselage. Interior sound pressure level transfer function data for isolators with varying mechanical properties were analyzed and compared to predicted transmission levels. The elastomeric isolators did not operate as constant property single degree-of-freedom systems with respect to noise isolation: noise isolation beyond approximately 150 Hz leveled off and decreased somewhat above 600 Hz. The frequency dependence of the isolator material properties was found to play an important role in the transmission of structure-borne noise in the mid- to high-frequency region of the spectrum; isolator stiffness was a strong parameter, while isolator damping was a much weaker parameter. Moderate changes to the lightweight high-strength engine mount structure did not affect the transmission phenomena. J.F.

A81-48610 # Prediction of flyover jet noise spectra. U. Michel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung Turbulenzforschung, Berlin, West Germany) and A. Michalke (Berlin, Technische Universität, Berlin, West Germany). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2025.* 9 p. 17 refs.

A scaling law is derived for predicting the flyover noise spectra of a single stream shock free circular jet from static experiments. The law is valid for unheated and heated jets, the theory being based on an experimentally supported similarity law for the influence of the flight velocity on the turbulent flow field of a jet. The resulting scaling laws for the difference between third octave spectra and the overall sound pressure are found to compare very well with flyover experiments with a jet engine and wind tunnel experiments with a heated model jet. C.R.

A81-48612 * # Theoretical and experimental evaluation of transmission loss of cylinders. Y. S. Wang, M. J. Crocker (Purdue University, West Lafayette, IN), and P. K. Raju. *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1971.* 10 p. 13 refs. NASA-supported research.

A technique is reported which evaluates the transmission loss of a cylinder from measurements of the incident and transmitted intensities. Incident intensity is calculated from the space-averaged measured pressure and the assumption that the source space is reverberant. Transmitted intensity is measured by means of the microphone acoustic intensity technique using a fast Fourier transform analyzer. The first dip at the ring frequency, and the other at the critical coincidence frequency are predicted in the transmission loss curve of a cylindrical shell with a 0.762 m diameter and a 1.67 m length. Results are compared and demonstrate good agreement for frequencies above 500 Hz. It is concluded that the technique combining the measurement of both intensities gives accurate results and is simpler and less expensive than the conventional method. D.L.G.

A81-48613 * # Experiments on the nonlinear characteristics of noise propagation from low and moderate Reynolds number supersonic jets. J. A. Gallagher and D. K. McLaughlin (Oklahoma State University, Stillwater, OK). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2041.* 9 p. 10 refs. Grant No. NAG1-10.

A series of experiments were conducted on high-speed model jets to identify and quantify the distortion of radiated noise by nonlinear propagation effects. The jets were operated in a low to moderate Reynolds number range, and the radiated noise was either broadband or discrete in frequency. Three condenser microphones were used to measure the waveforms propagated by the axisymmet-

ric, cold model jets of Mach numbers 2.1 and 2.5. Relatively low Reynolds numbers were obtained by exhausting the jets into a low pressure anechoic test chamber. Nonlinear propagation distortion effects, such as wave steepening, harmonic generation and wave merging, were easily quantified. At a moderate Reynolds number, low frequency production and wave amalgamation, measured by a decrease in the zero crossings per unit time, were quantified in the propagation of sound away from the jet. J.F.

A81-48615 * # Tip geometry effects on the model helicopter rotor low frequency broadband noise. N. G. Humbad and W. L. Harris (MIT, Cambridge, MA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2003*. 14 p. 19 refs. Grant No. NSG-1583.

The effect of rotor blade tip shapes and performance parameters on the low frequency broadband noise (LFBN) is investigated experimentally. The experimental results show 2 to 5 dB reductions for swept geometries compared with square tip blades at constant blade loading. A theoretical model is formulated which includes a detailed lift response function. For the square tip blades, theoretical results are found to be in good agreement with the experimental results. While the effects of advance ratio and tip speed on the LFBN are explicable, those of blade loading are not clearly understood. C.R.

A81-48618 * # Laboratory study of efficient add-on treatments for interior noise control in light aircraft. J. S. Mixson, L. A. Roussos, C. K. Barton (NASA, Langley Research Center, Hampton, VA), R. Vaicaitis (Columbia University, New York, NY), and M. Slazak. *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1969*. 12 p. 15 refs.

Experimental and theoretical studies of the transmission loss (TL) of 1.15 x 1.46 m flat stiffened-skin aluminum panels are described. Panel configurations included panels with no treatment and eight combinations of treatments consisting of a fiberglass-septum layer, a foam-foil damping material, and a plywood double wall trim panel. Measured TL of the untreated panel and the panel with a damping layer showed characteristics of the double mass law: at low frequencies the TL followed a mass law trend associated with the average mass of both skin and stiffness, while at higher frequencies the TL followed a mass law trend associated with skin mass only. A comparison of TL for panels treated with a damping layer, a fiberglass layer, or a trim panel showed that the effects of damping are frequency dependent with some performing better below 500 Hz and others performing better above 500 Hz. Treatment combinations showed that two treatments with the same mass could have TL values different by about 10 dB, while other combinations having weights different by a factor of two could have TL values within a few dB over most of the frequency range. The highest TL values (50 dB at 1000 Hz) were obtained with a treatment consisting of a fiberglass layer, a trim panel, and damping layers on both the stiffened panel and the trim panel. J.F.

A81-48620 # Engine noise source breakdown - Theory, simulation and results. B. J. Tester (Rolls-Royce, Ltd., Derby, England) and M. J. Fisher (Southampton University, Southampton, England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2040*. 11 p.

Cross-spectrum measurements in the far-field of an aero-engine are processed to form a source image along the engine axis. The intensity of the intake, bypass, core and mixing noise sources is estimated from the image, provided the sources are well separated on the wavelength scale. The 'best squares' fit procedure is used to automate the source breakdown calculation by eliminating the source-image stage of data analysis, thereby permitting larger volumes of data to be processed. Numerical studies and practical results demonstrate that the method can be used at far lower frequencies than those for which individual source contributions could be discerned from a resolution limited source image. Far less comprehensive microphone arrays are required, since there is no general aliasing problem. Application of this technique to the separate core and jet mixing noise on a Viper engine yields a range of valuable data, previously unavailable; the technique is not restricted to a line array of point sources, but can be extended to an arbitrary array of either compact or noncompact sources. J.F.

A81-48621 * # Turbomachinery noise studies of the AiResearch OCGAT engine with inflow control. J. G. McArdle, L. Homyak, and D. D. Cnruiski (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2049*. 16 p. 17 refs.

The AiResearch Quiet Clean General Aviation Turbofan engine was tested on a vertical lift fan facility to measure the acoustic performance of two inflow control devices (ICD) of similar design, and three inlet lips of different external shape. Far-field directivity patterns calculated by existing analyses were compared with the measured fan fundamental blade passing frequency (BPF/F) and broadband data. Installing an ICD on an engine with hardwall ducts reduced the BPF(F) tone everywhere in the far-field. When the ICD was installed on an engine with active acoustic panels, tone reduction in the forward quadrant was comparable to that in the hardwall tests; in the aft quadrant, however, tone noise was attenuated by the large acoustic panels in the bypass duct to such a degree that the ICD had little effect. Tests to compare performance of ICDs with hardwall inlet ducts showed only minor differences in the BPF(F) directivity patterns, while broadband noise was the same for both. Forward-quadrant BPF(F) and broadband directivity patterns were found to be similar for the inlet lips tested with a hardwall inlet duct. At high fan speeds, however, the shape of the analytical multimodal tone pattern from the exhaust nozzle was flatter than the measured patterns. The sources of lobes from several propagating single modes found in the forward-quadrant BPF(F) data were attributed to rotor/strut interaction and the rotor-alone pressure field. J.F.

A81-48625 * # Contributions to the theory of side edge flap noise. M. S. Howe (Bolt Beranek and Newman, Inc., Cambridge, MA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2036*. 11 p. 17 refs. NASA-supported research.

High and low frequency asymptotic formulas are derived which express the acoustic frequency spectrum in terms of the wavenumber-frequency spectrum of surface pressure fluctuations on the upper surface of a part span flap, measured in-board of the side edge. Interpolations between the results are used to predict the field shape and its dependence on the subsonic forward flight speed over the whole frequency range. The radiation has the characteristics of a semibaffled dipole at small values of the Strouhal number based on the chord of the flap and the forward flight speed. The degree of Doppler amplification due to forward flight speed of the aircraft is dependent on the Strouhal number: the radiation efficiency of side-edge noise sources is governed by the value of the mean side-edge gap Strouhal number, and is larger when this number is small. Theoretical predictions extrapolated to full scale suggest that the noise generated at a single side edge can exceed that generated along the whole of the trailing edge of the flap by 3 dB. J.F.

A81-48626 * # Prediction of jet exhaust noise on airframe surfaces during flight. L. M. Butzel (Boeing Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2035*. 14 p. 16 refs. Research supported by the Boeing Commercial Airplane Co.; Contracts No. F33657-72-C-089; No. F33615-77-C-3035; No. NAS2-9328.

The behavior of pressure fluctuations measured on the airframe of a prototype high lift jet transport (YC-14) is presented. The data are characterized in terms of a particular jet exhaust flow field idealization, jet mixing noise, and exhaust shock noise. Generalized spectrum shapes and scaling relations for peak level and frequency of peak level are developed, and the frequency is found to depend on jet exhaust velocity and aircraft velocity. Comparisons are made with near-field engine exhaust noise of a conventional jet, and results suggest that the same two exhaust noises are important for both aircraft types. Surface fluctuating pressure data are assessed, and results suggest that the jet mixing and exhaust shock noise source characterizations for the YC-14 have useful applicability to conventionally configured jets. D.L.G.

A81-48627 # The effect of vane-frame design on rotor-stator interaction noise. P. Y. Ho (General Electric Co., Aircraft Engine Business Group, Evendale, OH). *American Institute of Aeronautics*

and *Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2034*. 11 p. 20 refs.

Test results of a conventional uniform outlet vane design and an integral vane frame are reported. A turbulence control structure installed over a 20-inch-diameter motor-driven fan inlet is used to determine the difference in overall noise levels. Aerodynamic and acoustic measurements are made for 12 min of recording at a tape speed of 7.5 in./sec, and a method for calculating the steady state potential field noise by struts and pylons is presented. It is found that integral vane-frame design causes blade passing frequency cut-on at low speeds. Rotor-stator spacing is observed as having a severe impact on rearward propagating noise in terms of broadband and tone levels; however, due to large rotor-stator spacing and a smaller rotor incidence angle for the vane-frame design, the overall difference in noise levels between the two configurations is insignificant. It is concluded that in actual engine design practice, an integral vane-frame design is acceptable when sufficient spacing is given between the rotor trailing edge and the vane-frame leading edge. D.L.G.

A81-48628 * # Effects of blade-vane ratio and rotor-stator spacing on fan noise with forward velocity. R. P. Woodward and F. W. Glaser (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2032*. 12 p. 30 refs.

A research fan stage is acoustically tested in an anechoic wind tunnel with a 41 m/sec tunnel flow. Two stator vane numbers giving cut-on and cut-off conditions are tested at three rotor stator spacings ranging from 0.5 to 2.0 rotor chords. Hot-film anemometer turbulence measurements are made at the leading edge of the stator for each spacing, and a crossed film anemometer is radially transversed to define streamwise and upwash characteristics of the rotor blade wakes. Trends in the acoustic results are observed in the front and aft quadrants at 80% design fan speed. Aft quadrant results demonstrate a fundamental tone 9 dB lower for the 25 vane stator than for the 11 vane stator, while overtone levels are 3 dB higher. The cut-off criterion strongly controls fundamental tone level at all spacings, and spacing trends of the wake-defect upwash component show good agreement with corresponding cut-on acoustic tone levels. D.L.G.

A81-48629 # Flight test of the 747-JT9D for airframe and jet-flap interaction noise. O. Kipersztok and G. Sengupta (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2037*. 10 p. 7 refs.

This paper describes the methodology used to isolate the individual airframe noise components and determine their relative contribution to the total noise radiated by a 747 aircraft with JT9D-7A engines at approach. The individual components are isolated using ensemble averaged flight test data. The spectral data are normalized on the basis of altitude, airspeed, temperature, and relative humidity. The noise radiated at approach is reconstructed from addition of individual components and compares very accurately, in level, spectral shape and directivity pattern, to the actual flyover. A comparison is made between each individual airframe noise component and their logarithmic sum, representing the synthesized total airframe component, and Fink's prediction method. The results of this study show that the landing gear, when isolated from configurations having the flaps retracted, is the major contributor to airframe noise. If the effect of flap deployment is included in the isolation of the landing gear noise component, this result could be altered. No evidence of significant jet-flap interaction noise is found for the 747-JT9D aircraft. (Author)

A81-48634 # Comparative acoustic wind-tunnel measurements and theoretical correlations on subsonic aircraft propellers at full-scale and model-scale. W. J. G. Trebble, J. Williams (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England), and R. P. Donnelly (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants.; Dowty-Rotol, Ltd., Cheltenham, England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2004*. 15 p. 14 refs.

Experiments are performed on a Dowty-Rotol four-bladed R292 propeller at full scale in a 24 ft anechoic tunnel, and at quarter-scale on a geometrically similar model in a 1.5 m acoustic tunnel.

Measurements of power, torque and thrust are simultaneously made with microphone recordings of the propeller noise signal. Third-octave and narrow-band spectra are analyzed in a range of rotational speeds up to a blade-tip Mach number of 0.75 with tunnel airspeeds up to 50 m/s. Variation of propeller nacelle incidence up to 10 deg has little effect on noise level, and the empirical relationship from tunnel full-scale tests correlates with measurements from external fuselage-mounted microphones on a twin propeller Shorts 330 aircraft, although installation effects raise the absolute level by 7 dB. The quarter-scale model has similar acoustic and aerodynamic characteristics to those of the full-scale propeller, and substantially better noise measurements are attainable in the 1.5 m acoustic tunnel than in the 24 ft anechoic tunnel. D.L.G.

A81-48635 * # Comparison of predicted engine core noise with current and proposed aircraft noise certification requirements. U. H. von Glahn and D. E. Groesbeck (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2053*. 11 p. 15 refs.

Predicted engine core noise levels for subsonic CTOL aircraft engines are compared with measured total aircraft noise levels and to the spectral envelope, with a peak at 400 Hz which is assumed to be shifted in flight by a Doppler shift in frequency. Perceived noise levels are computed for appropriate engine power settings at desired flight conditions, and reductions in sideline noise levels are made to account for jet and airframe shielding effects. Results indicate that core noise can provide a barrier to the proposed EPA stage 4 and 5 federal noise rules for wide-body aircraft, with the most severe core noise problem occurring at takeoff and sideline measuring stations. D.L.G.

A81-48636 # Some modal-frequency spectra of fan noise. T. G. Sofrin. *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1990*. 12 p.

Features of fan-compressor noise are described by means of modal-frequency spectra, which give both modal and frequency distributions of acoustic power. A simple form of spectral function is used, which allows fan noise spectral characteristics to be easily estimated in terms of design and operating characteristics. Examples of modal-frequency spectra are given for rotor-stator interaction, turboprop interactions, a two-stage fan, and inlet distortion interactions. Methods for reducing inflow turbulence present during ground tests are described, and the development of improved quiet fan designs is found to depend on the ability to measure mode structure. Several significant fan noises are illustrated, including examples of discrete frequency, multiple pure tone, and broadband noise. In addition, due to static operation producing strong inflow turbulence interactions, and unacceptably restrictive and expensive flight development testing, more effort is being placed on reducing static environmental effects. D.L.G.

A81-48637 * # Assessment of inflow control structure effectiveness and design system development. A. A. Peracchio (United Technologies Corp., Pratt and Whitney Aircraft Group, East Hartford, CT). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2048*. 12 p. 5 refs. Contract No. NAS1-15085.

Inflow control structures used during static testing of fans are shown to minimize inflow distortions and thus stimulate the inflight flow field and noise generating mechanisms. Acoustic tests are conducted on a Pratt and Whitney aircraft JT9D engine with and without an inflow control structure. Raw data are corrected to 77 deg, and time is averaged over 0.5 second intervals. Use of an inflow control structure is found to significantly reduce blade passage frequency tone, while having little effect on twice blade passage frequency tones, and significantly improves agreement between static data projected to flight and flight data for the blade passage frequency fan tone. A design system is also presented, which prescribes structure shape, size and construction. D.L.G.

A81-48638 * # Ground effects on aircraft noise for a wide-body commercial airplane. W. L. Willshire, Jr. (NASA, Langley Research Center, Hampton, VA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA,*

Oct. 5-7, 1981, Paper 81-1988. 8 p. 10 refs.

Ground effects on noise from a high-bypass ratio engine aircraft are investigated. A 747 is flown at altitudes from 30 to 960 m past a 20-microphone array, and ground effects are calculated from noise measurements as a function of elevation angle and slant range. Results are given in terms of EPNL units and are compared with previous results of a turbojet-powered T-38 and SAE-recommended empirical lateral attenuation prediction procedures. Theoretical predictions are made based on a method developed by Pao et al. (1978) and are compared with both 747 and T-38 results, demonstrating good agreement although a consistent underprediction of peak measured attenuation is observed. Measured ground effects are found largest at 200 Hz, and no definite shielding differences are apparent for a directivity angle of 122.5 deg. Less lateral attenuation of effective perceived noise is measured for both aircraft and is attributed to the dominance of low-frequency noise in the source spectrum. D.L.G.

A81-48639 * # Mixer nozzle aeroacoustic characteristics for the energy efficient engine. P. R. Gliebe, G. T. Sandusky (General Electric Co., Aircraft Engine Group, Cincinnati, OH), and R. Chamberlin (NASA, Lewis Research Center, Transport Propulsion Office, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1994*. 11 p. NASA-supported research.

Aeroacoustic tests are conducted on scale model mixer nozzle configurations, a separate flow nozzle, and a baseline conical nozzle in an anechoic chamber free-jet facility to investigate exhaust system designs. Far-field acoustic data and exhaust jet plume aerodynamic data are obtained for various combinations of exhaust jet velocity and simulated flight speed, with corrected microphone data at a constant 12.2 m arc distance, and scaled acoustic data at a sideline distance of 457 m. It is found that jet plume aerodynamic and acoustic characteristics of lobed mixer exhaust systems are similar to those of a conical nozzle operating at the same specific thrust, although differences occur at high frequencies, where the sound pressure level of the mixer nozzle is 1-5 dB higher than that of a conical nozzle. In addition, no direct correlation is found between exit plane turbulence levels and plume development or acoustic characteristics for mixer exhaust configurations. D.L.G.

A81-48640 * # Acoustic and turbulence measurements of a tone-excited jet with and without flight simulation. K. K. Ahuja, J. Lepicovsky, and R. H. Burrin (Lockheed-Georgia Co., Marietta, GA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2007*. 12 p. 10 refs. Research supported by the Lockheed-Georgia Co.; Contract No. NAS3-21987.

Acoustic as well as turbulence measurements were made of tone-excited jets to obtain an understanding of the broadband noise augmentation mechanism. Results for both heated and unheated jets with and without flight simulation are presented for a range of excitation frequencies and levels, as well as for the zero order and first order spinning modes. It is argued that although the phase-locked large-scale turbulence structure is at the root of the noise amplification process, the actual noise generation mechanism lies in the small-scale turbulence. Results show that (1) the phase velocity of the excited large scale instability waves is subsonic relative to the ambient fluid and (2) broadband jet noise is almost uniform at all frequencies. Moreover, when the large-scale and small-scale structures are plotted against forward velocity (for a given upstream excitation level of 141 dB), the change in large-scale turbulence is negligible with forward velocity, whereas the small-scale turbulence decreases for both excited and unexcited jets. Also, the corresponding difference in far-field noise does not appear to change significantly, indicating that the changes in small-scale turbulence are responsible for jet noise amplification. J.F.

A81-48644 # Prediction method for aeroacoustic loads on under the wing blown flaps. D. Lohmann (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung technische Akustik, Braunschweig, West Germany). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2038*. 11 p. 15 refs.

Regression analyses are performed based on fluctuating surface-pressure data from the McDonnell-Douglas YC-15 STOL prototype

aircraft to develop a prediction scheme for aeroacoustic loads on under-the-wing blown flaps. Flight and engine exhaust Mach numbers, flap angle, and flight-altitude are used as primary parametrical variables to calculate third-octave band surface pressure level spectra and overall levels for any chord station on the lower surface of the wing/flap system. Experimental results indicate that the frequency range for 20-2000 Hz is most critical in terms of structural fatigue life, and a marked influence of altitude on overall fluctuating surface-pressure levels appears only in the range from 0 to 10,000 ft, while the difference is less than 2 dB between 10,000 and 30,000 ft. In the case of ground static, the aeroacoustic energy increases with the 3rd and 4th powers of the nozzle exit Mach number, while in the flight case, the energy increases with the 8th to 10th powers of the relative Mach number, which agrees well with predictions. D.L.G.

A81-48647 # A novel airborne technique for free-field measurements of aircraft noise above the flight path with application to noise-shielding studies. T. A. Holbeche and A. F. Hazell (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2028*. 12 p. 9 refs.

Wind-shielding effects for a TriStar airliner are deduced from a comparison of engine noise measured simultaneously above and below the flight path. Noise radiated upward is monitored by flying the aircraft beneath a large instrumented fiberglass sphere suspended from a hovering helicopter, while flyover noise at ground level is recorded conventionally. Predicted acoustic diffraction by the sphere results in good directivity and frequency response characteristics, allowing reliable free-field noise data to be readily derived from the fly-under. Experimental checks on this behavior at model and full-scale are reported, including the results of diffraction studies on a half-scale sphere in an anechoic room. Basic considerations regarding application of the technique to noise-shielding studies in flight are outlined and corrections to free-field conditions are evaluated for a range of typical frequencies and sound incidence angles. Most corrections are -6 dB and independent of the source distance, and efficient shielding by the sphere leads to a substantial reduction in helicopter background noise, which improves reliability of the aircraft noise measurements. D.L.G.

A81-48651 # Effect of excitation on coaxial jet noise as observed by an elliptic mirror. H. Y. Lu (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2044*. 9 p. 8 refs.

Coaxial model jets are excited internally by tone and broadband noise under high-bypass-ratio (HBPR) engine exhaust hot gas conditions. The system consists of an internal noise injection section installed 4 ft from the nozzle exit, and 16 Altec horn drivers rated at 50 W per driver. Rotational motion is remotely controlled, and transverse recording is made at 60, 90, 120, and 140 deg. Amplification is found to depend on nozzle configuration, gas conditions, excitation frequencies, and excitation levels and location. HBPR jets without internal acoustic excitation are also examined by using the elliptic mirror, and the secondary ambient premerged jet noise is found to dominate the upstream angles. Acoustic excitation in the secondary duct is most effective due to the sensitivity of the outer shear layer, where jet noise amplification occurs in the subharmonic in a number of cases. In addition, due to increased mixing and higher noise levels of the excited jet, the noise source region is more compact than in unexcited jets, and comparisons of excess jet noise characteristics with HBPR engine noise data indicate that HBPR engines have excess noise. D.L.G.

A81-48653 # High bypass ratio engine noise component separation by coherence technique. B. N. Shivashankara (Boeing Commercial Airplane Co., Seattle, WA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2054*. 12 p. 13 refs.

Aft fan, core and jet noise components of a large high bypass ratio engine are separated by means of a signal enhancement technique. Simultaneous signals from three or more microphones are used, which are assumed to have a common correlated part and uncorrelated extraneous noise at each location. Advantages include the internal-to-farfield coherence technique used for component separation when the in-duct microphone signal is contaminated by

extraneous noise, and the separation of jet noise from core and fan noise using only far-field microphones. The validity of the technique is demonstrated by a scale proof-of-concept experiment, and the technique is applied for use with signals from three microphones external to the engine. Higher-frequency fan tones are well correlated between fan duct and far-field microphones, which indicates that higher-frequency fan noise tones, such as the blade passage frequency tone, are due to distributed and well correlated sources. D.L.G.

A81-48744 # Choice of optimal parameters of a gyrovertical on the basis of a standard program (Vybor optimal'nykh parametrov girovertikali po tipovoi programme). M. A. Sergeev, V. A. Iablonskaia, and A. A. Kubenskii (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR). *Priboroostroenie*, vol. 24, Aug. 1981, p. 78-84. In Russian.

Algorithms are presented for computing the mean-square error of a gyrovertical with a mixed correction characteristic on the basis of a standard program. A method for choosing the optimal parameters of the gyrovertical is described. B.J.

A81-48847 Unrepresentative temperatures at a first-order meteorological station - Washington National Airport. J. L. Foster and R. J. Leffler. *American Meteorological Society, Bulletin*, vol. 62, July 1981, p. 1002-1006. 9 refs.

An examination of temperature records from the three major airports in the Washington, DC, area and from a network of volunteer meteorological observers reveals an exceptional warmth at Washington's National Airport and indicates that National Airport does not represent properly temperature conditions normally experienced in the Washington Metropolitan Area. Temperature differences between National Airport and its environs and other meteorological stations in the Middle Atlantic region can be attributed primarily to the location of National Airport within Washington's heat island and to the proximity of its temperature sensors to the modifying effects of the Potomac River. (Author)

A81-49075 More fight for the Fighting Falcon. A. T. Lloyd. *Air International*, vol. 21, Oct. 1981, p. 161-170, 202, 203.

A status report is given on technical developments made and operational experience gained in the first five years of F-16 use by U.S., European, and Israeli air forces. Attention is given to the manufacturer's Multinational Staged Improvement Program (MSIP), whose three stages will cover aircraft produced until 1989, aimed at the gradual introduction of advanced avionics and weapon systems. Consideration is also given to the U.S. Air Force's F-16 flight training and maintenance programs, European F-16 construction schedules, operation to date by the Belgian, Dutch, Danish and Norwegian air forces, and two advanced development programs: (1) the Supersonic Cruise Aircraft Modification Program, involving a lengthening of the fuselage and incorporation of a large-area cranked arrow wing, while maintaining 93% commonality with the current airframe and (2) the Advanced Fighter Technology Integration demonstrator, employing control-configured vehicle technology and canard control surfaces. O.C.

A81-49076 * # Structural synthesis - Its genesis and development. L. A. Schmit (California, University, Los Angeles, CA). *A/AA Journal*, vol. 19, Oct. 1981, p. 1249-1263. 101 refs. NASA-supported research.

An historical account is given of the development, from its conception in 1960, of the structural synthesis method. While synthesis techniques lag behind analytical ones in both sophistication and application, the structural design procedures created by combining finite element analysis and mathematical programming algorithms have progressed to the point of maturity. As in the case of finite element analysis, use and acceptance of structural synthesis methodology depends on the development and distribution of easily used and well-documented, production-quality computer programs. Attention is given such elementary applications of synthesis methods as the three-bar truss, an integrally stiffened waffle plate, a stiffened cylindrical shell, aircraft fuselage window panels, the structural efficiency of graphite-epoxy hat-stiffened panels, and an idealized delta wing. O.C.

A81-49161 # Propulsion energy for tomorrow's aviation (Antriebsenergie für die Luftfahrt von morgen). V. M. Akimov

(Tsentral'nyi Nauchno-Issledovatel'skii Institut Aviatsionnogo Motostroeniia, Moscow, USSR). (*Grazhdanskaia Aviatsiia*, no. 2, 1980.) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol. 17, no. 2, 1981, p. 68-71. In German. (Translation).

One of the objectives of the Central Institute for the Construction of Aircraft Engines in the USSR involves the study of the characteristics for the aircraft propulsion system to be used at the end of the 20th and the beginning of the 21st century. Conclusions reached in this study are discussed. Further improvements in the efficiency of new propulsion units will be possible on the basis of a high bypass ratio and better operational parameter values. It is pointed out that the design of engines of the new generation will require the solution of complex problems concerning gas dynamics, cooling, and materials. The efficiency of turbine and compressor must be further enhanced and the space remaining between moving and stationary parts in compressor and turbine must be reduced. It is expected that, as a result of these steps, it will be possible to obtain a further reduction in fuel consumption by about 10 to 12%. Attention is also given to approaches for increasing the production of aircraft fuels on a hydrocarbon basis, and possibilities for an employment of hydrogen as aircraft fuel. G.R.

A81-49173 Combat cockpit design. *Flight International*, vol. 120, Sept. 26, 1981, p. 939-942.

A status report is presented on attempts to give NATO single-seat fighter pilots, whose aircraft are currently being produced at a rate four times greater than that of two-seat combat aircraft, the greatest range of control capabilities against increasingly sophisticated Soviet antiaircraft systems. After surveying the threat posed by four new Soviet SAM systems, the Ram-J, -K and -L aircraft nearing production and the AWACS/Super Foxbat interception system, recent developments in digital radar mode and weapons control, displays, track-while-scan radar, ECM, and automatic, built-in testing of aircraft systems are described. Attention is given design solutions for the F-16, F-18 and AV-8B aircraft, as well as related developments in the A-10 and F-15. Detailed descriptions are given of the WDNS-141 weapon-delivery and navigation display system and the AV-8B joystick- and throttle-mounted, 'hands on' control devices. O.C.

A81-49209 A process for protecting gas turbine blade cooling passages against degradation. J. E. Restall, B. J. Gill (National Gas Turbine Establishment, Farnborough, Hants., England), C. Hayman, and N. J. Archer (Fulmer Research Institute, Ltd., Stoke Poges, Bucks., England). In: *Superalloys 1980; Proceedings of the Fourth International Symposium*, Champion, PA, September 21-25, 1980. Metals Park, OH, American Society for Metals, 1980, p. 405-411. 5 refs.

A new process for the protection of turbine blades and vanes on both external and internal surfaces has been evolved. The surfaces are metallized by pressure-pulsing the coating gases from a near-conventional cementation pack. Penetration occurs into the internal cooling channels which are inaccessible to most other coating processes. Up to 1000 small turbine blades can now be simultaneously pulse aluminized in an industrial plant. (Author)

A81-49374 # Performance prediction for light airplanes. E. V. Laitone (California, University, Berkeley, CA). *Journal of Aircraft*, vol. 18, Nov. 1981, p. 988-991. 6 refs.

Oswald's (1932) method for estimating the performance of aircraft with fixed-pitched propellers is extended to modern aircraft with variable pitch propellers. A parabolic variation of the thrust with the flight velocity makes possible the development of explicit relations for the maximum level flight speed and the maximum rate of climb at any altitude up to the absolute ceiling. It is shown that errors may occur if the limitations of the best-fit parabola are exceeded, and that the performance calculations are greatly simplified by representing the propulsive thrust by a parabola. D.L.G.

A81-49375 * # Influence of landing gear flexibility on aircraft performance during ground roll. M. M. Sivaramakrishnan (NASA, Langley Research Center, Hampton, VA; Indian Institute of Technology, Bombay, India). *Journal of Aircraft*, vol. 18, Nov. 1981, p. 991, 992.

An analysis is made of the influence of landing gear deflection characteristics on aircraft performance on the ground up to rotation.

A quasi-steady dynamic equilibrium state is assumed, including other simplifying assumptions such as calm air conditions and normal aircraft lift and drag. Ground incidence is defined as the angle made by the mean aerodynamic chord of the wing with respect to the ground plane, and equations are given for force and balance which determine the quasi-equilibrium conditions for the aircraft during ground roll. Results indicate that the landing gear deflections lead to a substantial increase in the angle of attack, and the variation in the ground incidence due to landing gear flexibility could be as much as + or - 50%, and the reduction in tail load requirements almost 25%.

D.L.G.

A81-49378 # Compact and highly sensitive fluorescence lidar for oceanographic measurements. U. Gehlhaar, K. P. Gunther, and J. Luther (Oldenburg, Universität, Oldenburg, West Germany). *Applied Optics*, vol. 20, Oct. 1, 1981, p. 3318-3320, 12 refs. Research supported by the Deutsche Forschungsgemeinschaft.

A compact and highly sensitive helicopter-borne fluorescence lidar is described. The single channel system is based on a high power, tunable laser. From an altitude of 70 m, selective detection of the tracer dye rhodamine B of less than 10 to the -10th g/cu cm in natural waters is achieved. (Author)

A81-49462 # Automation of air traffic control processes (Avtomatizatsiia protsessov upravleniia vozdušnym dvizheniem). Iu. P. Darymov, G. A. Kryzhanovskii, V. A. Solodukhin, V. G. Kiv'ko, and B. A. Kirov. Moscow, Izdatel'stvo Transport, 1981. 400 p. 229 refs. In Russian.

The work presents a systematic exposition of the principles underlying the automation of ATC processes as well as the principles of the technical implementation of automatic ATC systems. Particular consideration is given to the development of mathematical models for ATC processes, the evaluation of the efficiency of automatic ATC systems, and the development of algorithms for the automation of ATC processes. B.J.

A81-49471 # Stress concentration in elements of aircraft structures (Kontsentratsiia napriazhenii v elementakh aviatsionnykh konstruktstii). R. R. Mavliutov. Moscow, Izdatel'stvo Nauka, 1981. 144 p. 216 refs. In Russian.

The book deals with methods of calculation and experimental determination of stress concentrations in typical elements of aircraft structures. Emphasis is placed on problems of stress concentration in parts subjected to elastic, plastic, and creep deformation under complex loading conditions. The effect of loading history is evaluated. Computer algorithms and programs for stress calculation are presented together with design optimization guidelines. V.L.

A81-49475 # Design of production processes for flight-vehicle engines (Proektirovanie tekhnologicheskikh protsessov proizvodstva dvigatelei letatel'nykh apparatov). I. A. Ivashchenko. Moscow, Izdatel'stvo Mashinostroenie, 1981. 224 p. 22 refs. In Russian.

Principles underlying the design of production processes for aircraft and rocket engines are examined. Particular attention is given to metal-treatment accuracy, the quality of the surface layers of engine parts, tolerances, and improved (particularly automated) methods for the mechanical treatment of engine parts. B.J.

A81-49575 # Commercial airliners - Design and flight operation (Las aeronaves comerciales - Diseño y operación de vuelo). M. Cuesta Alvarez. *IAA/Ingeniería Aeronáutica y Astronáutica*, vol. 33, Aug.-Sept. 1981, p. 17-34. In Spanish.

After a brief review of historical trends in jet airliner range and passenger-carrying capacity, consideration is given to a variety of topics in airliner design. These include: (1) sizing, with attention to the market opportunities that will exist until the year 2000 for medium-range aircraft with capacities in the 130-160 and 160-200 seat categories; (2) configurations, with stress on the drag reduction and structural load alleviation that may be derived from supercritical profile wings; (3) structures, with emphasis on the role that may be played by such advanced materials as the 7000 series aluminum alloys and carbon- and boron-reinforced composites; (4) high-bypass turbofan engine design; (5) active control technology for flutter suppression and gust load alleviation; and (6) the determination of flight profiles optimized for maximum range and for minimum direct operating costs. O.C.

A81-49727 # The effect of flight and the presence of an airframe on engine exhaust noise. S. Bashforth (Rolls-Royce, Ltd., Derby, England). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2029*. 13 p. 15 refs.

A full-scale static and flight test program using an HS 125 aircraft with an RR Viper 601 turbojet was carried out in order to explain the anomalies found between full-scale in-flight exhaust noise studies and model simulations. Both acoustically lined and unlined engine tailpipes were tested, and extensive installation studies were conducted using a replica tail assembly. Source location techniques were used to determine core noise levels over a wide range of frequencies. It is shown that the discrepancy between the static and flight tests was due to a number of noise-producing and/or affecting features of the aircraft/aero engine combination which were not incorporated into the analyses of the data: static tests conducted at NASA Ames demonstrated the importance of installation effects, and flight tests revealed that airframe self-noise can cause a significant amount of the total noise in small aircraft. J.F.

A81-49728 * # Flight effects on supersonic convergent-divergent nozzle jet noise. J. Wat and V. Sarohia (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2027*. 9 p. 12 refs.

The influence of forward flight on the noise generation from convergent-divergent (C-D) nozzle flows was determined experimentally. The experiments were performed in an anechoic chamber using a 2.03 cm diameter C-D nozzle with a design Mach number of 1.4 in a 25 cm diameter free jet flow. Far-field noise measurements and spectral analyses were carried out and visualization of the jet shock structure was made by a spark shadowgraph technique. Jet noise from supersonic C-D nozzle flows under forward flight was found to depend critically on the flight velocity and nozzle pressure ratio. Noise reduction up to 20 dB was observed in the rearward quadrant under flight; excess noise in the forward quadrant under flight resulted from relatively high frequency noise sources in the jet flow field. Screech tones, observed from overexpanded C-D nozzle flows, were suppressed during the simulated flight flow. J.F.

A81-49729 * # Noise radiated from inverted velocity profile jets under simulated flight. R. A. Petersen and V. Sarohia (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2026*. 8 p. 13 refs. Contract No. NAS7-100.

Measurements were made of the noise radiated by an inverted profile coannular jet. The measurements were made inside an anechoic chamber and forward flight was simulated with an open jet surrounding a coannular nozzle. The diameters of the center and the annular nozzles were 1.27 cm and 2.03 cm, respectively. The open jet wind tunnel was 17.1 cm in diameter and could be operated at speeds up to 150 m/sec. Noise measurements were made in the acoustic far field at several spherical angles ranging from 20 deg to 120 deg relative to the jet axis. Flow through the center jet decreased the noise radiated by the annular jet. The addition of forward velocity further decreased the noise, and the two noise reductions seem to be additive. Measurements of the mean velocity profile demonstrate that forward flight reduced the growth rate of the high speed annular jet, and that center flow reduced the rate of merging of the annular jet. (Author)

A81-49730 # Shielding concepts for jet noise. R. L. M. Wong, W. G. Richarz, and H. S. Ribner (Toronto, University, Toronto, Canada). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2020*. 13 p. 33 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada; Grant No. AF-AFOSR-75-2808B.

Point source shielding is investigated as a function of frequency and source/observer positions for a semiinfinite shield. Several concepts for jet noise shielding are explored, and model experiments center on semiinfinite sugar scoop, and infinite planar shields. Results are synthesized into a predictive algorithm for jet noise shielding, in which the jet is modeled as a line distribution of incoherent sources with narrow-band frequency. Edge noise is minimized by hyperbolic cutouts and hybrid shields, and shielding

attenuation increases steadily with frequency following low-frequency enhancement by edge noise. Calculated ground contours of peak flyover perceived noise level (PNdB) show a substantial contraction due to shielding which reaches 66% for one sugar scoop shield for the 90 PNdB contour. Results show good agreement with companion analytical calculations, and the mean of two predictive versions agrees with the experimental results from 1 to 1.5 dB up to moderate frequencies. D.L.G.

A81-49731 * # Noise shielding by a hot subsonic jet. A. Vijayaraghavan and S. P. Parthasarathy (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2018.* 6 p. 5 refs. Contract No. NAS7-100.

An analysis is conducted of the shielding of the noise emitted by a high speed round jet by a hot, subsonic, semicircular jet. A plane wave front in the primary jet is resolved into elementary plane waves which undergo multiple reflections at the jet boundaries of the primary and the shielding jets. The jet boundaries are idealized to be vortex sheets. The far field sound is evaluated asymptotically by a superposition of the waves that penetrate the shielding jet. The angular directivities are plotted for several values of jet temperature and velocity to examine the effectiveness of shielding by the semicircular jet layer. (Author)

A81-49732 # Investigation of performance, noise and detectability characteristics of small-scale remotely piloted vehicle (RPV) propellers. D. S. JanakiRam (Hughes Helicopters, Inc., Culver City, CA) and B. W. Scruggs (U.S. Army, Applied Technology Laboratories, Fort Eustis, VA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-2005.* 15 p. 14 refs.

Several small-scale propeller configurations, applicable to a conceptual remotely piloted vehicle, were tested under static and simulated forward flight conditions in a wind tunnel to determine their performance, acoustic, and detectability characteristics. The propellers tested had tractor, pusher, and ducted configurations, designed to develop 4 thrust horsepower at a cruise speed of 75 knots at 4000 ft altitude and 95 F. The acoustic data were used to determine the slant range and altitude of no detection of each propeller configuration. The acoustic and detectability characteristics of small-scale propellers were found to be significantly different from those of the large-scale propellers; this is explained by low disk loading or the low operating Reynolds numbers of the propellers. An increase in forward velocity caused a significant drop in SPLs at higher harmonics of the blade passage frequency. Tip speed had a strong effect on noise and detectability in forward flight: most of the propellers were detected at either the first or second harmonic of their blade passage frequency. Three-bladed propellers were generally less detectable than two- or four-bladed propellers for most of the forward velocities. Finally, ducted and pusher propeller configurations were more detectable and less efficient than their free and tractor counterparts. J.F.

A81-49736 * # An iterative finite element-integral technique for predicting sound radiation from turbofan inlets. S. J. Horowitz, R. K. Sigman, and B. T. Zinn (Georgia Institute of Technology, Atlanta, GA). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1981.* 10 p. 23 refs. Grant No. NSG-3036.

A new iterative solution technique for predicting the sound field radiated from a turbofan inlet is presented. The sound field is divided into two regions; the sound field within the inlet which is computed using the finite element method and the radiation field outside the inlet which is calculated using an integral solution technique. A 'unified' solution is obtained by matching the finite element and integral solutions at the interface between the interior and exterior regions. The applicability of the iterative technique is demonstrated by considering several simple cases for which exact or 'classical' solutions for the sound field are available. These examples show that the proper solution is obtained within five iterations. The overall accuracy of the method is demonstrated by comparison with experimental data. (Author)

A81-49743 * # An improved prediction method for noise generated by conventional profile coaxial jets. J. R. Stone, D. E. Groesbeck, and C. L. Zola (NASA, Lewis Research Center, Cleveland, OH). *American Institute of Aeronautics and Astronautics, Aeroacoustics Conference, 7th, Palo Alto, CA, Oct. 5-7, 1981, Paper 81-1991.* 33 p. 13 refs.

A semi-empirical model for predicting the noise generated by conventional-velocity-profile jets exhausting from coaxial nozzles is presented and compared with small-scale static and simulated flight data. The present method is an updated version of that part of the original NASA Aircraft Noise Prediction (ANOP) Program (1974) relating to coaxial jet noise. That method has been shown to agree reasonably well with model and full-scale experimental data except at high jet velocities in the region near the jet axis. Improvements to the basic circular jet noise prediction have been developed since that time which improve the accuracy, especially at high jet velocity and near the jet axis, and are incorporated into the coaxial jet procedure in this paper. The new procedure is more theoretically based and has also been improved by some empirical adjustments. (Author)

A81-49877 Aircraft electricity and electronics /3rd edition/. R. D. Bent and J. L. McKinley. New York, McGraw-Hill Book Co., 1981. 365 p. \$16.95.

Fundamentals of electricity are considered along with magnetism and electromagnetism, capacitors and inductors, alternating current, and electric measuring instruments. Batteries are examined, taking into account voltaic cells, alkaline cells, nickel-cadmium cells, the theory of the lead-acid cell, aspects of lead-acid battery construction, battery design features, nickel-cadmium storage batteries, and a troubleshooting chart for nickel-cadmium batteries. A description is presented of generator theory, dc generators and controls, electric motors, the installation and maintenance of electrical systems, the principles of electronics, radio transmitters and receivers, electric instruments, and electronic control systems. Other topics considered are related to weather warning systems, communication and navigation systems, and automatic pilots and landing systems. Attention is given to radar, interphone communications, the passenger address and entertainment system, a high-frequency communication system, a Selcal decoder, Federal Communications Commission regulations, automatic direction-finder systems, the instrument-landing system, the microwave landing system, TACAN, long-range navigation systems, and an inertial navigation system. G.R.

A81-49900 # Model following control of gas turbine engines. R. V. Monopoli (Massachusetts, University, Amherst, MA). *ASME, Transactions, Journal of Dynamic Systems, Measurement, and Control*, vol. 103, Sept. 1981, p. 285-289. 18 refs. Research supported by the United Technologies Corp.

A technique, which is based on Liapunov's direct method (Kalman and Bertram, 1960), is described for designing a control system for a nonlinear gas turbine engine. The technique proceeds to the derivation of the control input directly from the nonlinear, time-varying differential equations, rather than from a linearized version of the engine dynamics. The control system resulting from this approach forces certain engine variables to track the corresponding variables of an ideal model of the engine specified by the designer. A brief description of the theory is presented, and the structure of the model is described. Application of the technique to a gas turbine engine is illustrated, using a full nonlinear digital simulation of a representative advanced technology engine. Simulation results are presented and include data indicating the performance achieved when the control algorithm was used. K.S.

A81-49928 # The use of direct lift control of an aircraft in a guided landing run (Ob ispol'zovanii nepostredstvennogo upravleniia pod'emnoi siloi samoleta v rezhime direktornogo zakhoda na posadku). O. Iu. Alashev, V. D. Osorgin, V. G. Pavlov, L. A. Semakov, and N. L. Sokolov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 13-18. 7 refs. In Russian.

The paper examines the possibility of using direct lift control to reduce the control time of the guided landing run under the condition that a satisfactory quality of the transient process be maintained. The synthesis of the guided control system is described in detail, and the precision of the technique under consideration is examined. B.J.

A81-49930 # The effect of the skewness of the skin panels on stresses in conical wings (Vliianie nepriamougol'nosti panelei obshivki na napriazheniia v konusnykh kryl'iax). M. B. Vakhitov and L. M. Koniukhova. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 22-27. 9 refs. In Russian.

A theoretical study is presented of the effect of additional normal stresses, arising in the case of the shear of skewed skin panels, on the stressed state of a conical wing. A discrete-continuum model is used to obtain a system of integrodifferential equations, which are solved by the method of integrating matrices. B.J.

A81-49935 # Geometrically nonlinear theory for calculating thin rods of a wing profile (Geometricheski nelineinaia teoriia rascheta tonkikh sterzhnei kryl'evogo profil'a). V. A. Pavlov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 44-50. 11 refs. In Russian.

The paper develops a theory of strength calculations of thin rectilinear rods of a wing profile of invariant cross-section shape; the spatial displacements of these rods are commensurable with their transverse dimensions. Deformations in local axes of rod elements are determined by generalized Kirchhoff-Klebsch relations. B.J.

A81-49937 # Strength calculation of thin-wall rods of significant taper (Raschet na prochnost' tonkostennykh sterzhnei znachitel'nogo suzheniia). V. G. Shataev. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 55-60. 7 refs. In Russian.

The paper examines a thin-wall cantilever beam structure consisting of longitudinal ribs connected by skin panels and transverse diaphragms. General equations are obtained for calculating the strength of this structure, with allowance for nonuniform heating, plastic deformation, and creep in the case of considerable taper. The physically nonlinear problem is reduced to a succession of linear problems by the use of the method of fictitious loads, secants, and tangential moduli. B.J.

A81-49940 # Parametric synthesis of an automatic system for flight-vehicle stabilization (K parametricheskomu sintezu avtomata stabilizatsii letatel'nykh apparatov). A. I. Bogomolov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 69-72. In Russian.

A81-49943 # Realization of a method of extremal targeting in a problem of aircraft landing control (O realizatsii metoda ekstremal'nogo pritselivaniia v zadache upravleniia samoletom na posadke). V. M. Kein, A. N. Parikov, and M. Iu. Smurov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 79-82. In Russian.

An algorithm is developed for aircraft terminal guidance which realizes the method of extremal targeting. The proposed algorithm was tested by a simulation of aircraft landing control in the case of extremal disturbances. The algorithm is found to satisfy prescribed speed and memory requirements. B.J.

A81-49946 # Choice of the optimal angular velocity of the twist of a flight vehicle (O vybore optimal'noi uglovoi skorosti zakrutki letatel'nogo apparata). O. A. Privarnikov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 102-104. In Russian.

During the twist of a flight vehicle, i.e., a rocket, relative to the longitudinal axis at the moment of separation from the booster, the rocket retains its orientation in the extraatmospheric part of the trajectory if the angular velocity of the twist considerably exceeds the transverse components of velocity. This paper considers the selection of the optimal twist velocity on the basis of minimum total deviation in range. B.J.

A81-49948 # Calculation of the aerodynamic characteristics of a deformable wing, moving near a screen (K raschetu nelineinykh aerodinamicheskikh kharakteristik deformiruemogo kryla, dvizhu-shchegosia vblizi ekrana). L. G. Tsvetkov. *Aviatsionnaia Tekhnika*, no. 2, 1981, p. 107-111. In Russian.

A theoretical study is presented of the motion of a thin wing at low subsonic velocity near a screen for low rates and amplitudes of the change of the kinematic parameters and deformation of the lifting surface. Particular attention is given to the effect of the three-dimensional motion on the formation of a vortex sheet behind the wing. B.J.

A81-49949 # Hydrogen engines (Dvigateli na vodorode). V. P. Barmin (Moskovskoe Vysshee Tekhnicheskoe Uchilishche, Moscow, USSR), I. L. Varshavskii, and V. V. Goncharov (Akademiia Nauk SSSR, Institut Mashinovedeniia, Moscow, USSR). *Priroda*, Sept. 1981, p. 22-29. In Russian.

The development of internal combustion engines fueled by hydrogen or hydrogen mixtures is reviewed. The first systematic investigations in the 1920s of a one-cylinder engine with variable compression ratio, which demonstrated the possibility of qualitatively regulated hydrogen combustion at any range of loading, resulting in a greater engine efficiency, is discussed, and problems of premature ignition encountered due to the use of pure hydrogen fuel are noted along with a possible solution in the use of a special injector for the direct delivery of the hydrogen to the cylinder which, however, leads to strong knocking. Attention is then given to work begun in 1974 on an experimental one-cylinder hydrogen-air engine with various degrees of compression and hydrogen supplied from ferrosilicon and water, the improvement of gasoline engine operating efficiency by 5-10% additions of hydrogen, hydrogen addition to diesel fuels, and hydrogen addition to improve the carbon monoxide, hydrocarbon and NO(x) emissions levels of aircraft gas turbine engines. A.L.W.

A81-49973 Civil head-up displays - Coming up fast. M. Lambert. *Interavia*, vol. 36, Oct. 1981, p. 984, 985.

A survey is made of operational experience to date with partial head-up display (HUD) systems installed in commercial aircraft. Attention is given these systems' certification for Category 3 operation. The systems described are the WGD 1, which is in service aboard A300 and 737-200 aircraft; the visual approach monitor (VAM), allowing ground-roll guidance in visibilities as low as 75 m; and the 193M electromechanical HUD for Mercure aircraft. Emphasis is given a recent HUD design, intended for DC-9 Super 80 airliners, which may be used during landing and take-off ground roll, climb, cruise, descent, instrument landing system approach, visual approach, and go-around. This HUD contains symbols indicating the autopilot's maneuvering capability in relation to the approach path, the phase of the approach, and the autopilot mode state. O.C.

A81-49974 Sukhoi Su-24 Fencer - The Soviet Tornado. G. Lafon. *Interavia*, vol. 36, Oct. 1981, p. 997-999.

Dimensional data and operational capabilities are deduced from photographs of the Soviet Su-24 Fencer interdiction/attack aircraft and from extrapolation of the characteristics of such comparable NATO aircraft as the F-111 and Tornado. After an examination of (1) the design's basic characteristics in light of the aerodynamic principles and structural requirements of low-level, high subsonic speed penetration missions, (2) the aerodynamic advantages and penalties of the large glove-area, variable incidence wing, and (3) the propulsion system difficulties resulting from deep, narrow air intakes intended to minimize radar cross-section, it is concluded that the Fencer is constrained to the interdiction strike mission, with little advantage at the high angles of incidence called for by air-to-air combat. In this, the Fencer compares unfavorably with the more versatile F-111 and Tornado. O.C.

A81-49975 The Lear Fan 2100. J. P. Geddes and D. Wood. *Interavia*, vol. 36, Oct. 1981, p. 1029-1033.

The structural, aerodynamic and propulsion system design features of the Lear Fan 2100 turboprop aircraft are described. The design incorporates two 850 shp turboshaft engines driving a four-bladed pusher propeller through a single transmission. Attention is given the all-graphite/epoxy composite construction of the fuselage and wings, designed for a 15,000-hour service life at high loads and 15,000 cabin pressure cycles, with a safety factor of 2.0 rather than the customary 1.5. Despite the novel materials employed, the structure is of a conventional, semimonocoque design that employs the stringers and frames of aluminum alloy aircraft. Also considered is the joint financing of the aircraft's development program by entrepreneurs and the British government, and the establishment of construction facilities in Northern Ireland. O.C.

A81-49976 # Graphite/polyimide augmentor and nozzle components. T. E. Schmid (United Technologies Corp., Pratt and Whitney Aircraft Group, West Palm Beach, FL). *AIAA, SAE, and*

A81-49979

ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1358. 13 p. 5 refs.

Two composite applications for the augmentor and nozzle section of advanced military gas turbine engines were designed, fabricated and tested to determine the cost and weight savings potential and to demonstrate the viability of using organic matrix composites as substitutes for sheet metal titanium structures. One of these components, the external nozzle flap, is currently undergoing flight service testing and may be considered for incorporation into the engine bill-of-material. Design approaches, configuration constraints, fabrication methods, and component test results are presented. (Author)

A81-49979 # **Comparison of computational and experimental jet effects.** J. L. Jacocks, W. L. Peters, and F. C. Guyton (ARO, Inc., Arnold Air Force Station, TN). *AIAA, SAE, and ASME, Joint Propulsion Conference, 17th, Colorado Springs, CO, July 27-29, 1981, AIAA Paper 81-1492. 9 p. 11 refs.*

Computations were made for transonic flow over a nozzle afterbody with a real plume. The effects of parameters such as nozzle pressure ratio, plume stagnation temperature, and interior nozzle shape on afterbody drag were quantified and compared with available experimental data. Remarkable agreement between the computational and experimental results is demonstrated, including the drag minimum associated with low nozzle pressure ratios and the absolute dependence of drag on temperature. The computer program used for the calculations is an axisymmetric modification of Diewert's planar Navier-Stokes program and utilizes a mixed explicit-implicit MacCormack algorithm with an algebraic turbulence model. (Author)

STAR ENTRIES

N81-32117*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.

WIND-TUNNEL STUDIES OF ADVANCED CARGO AIRCRAFT CONCEPTS Final Report, 22 Jun. 1979 - 21 Jun. 1980

D. M. Rao and G. L. Goglia Sep. 1981 17 p refs (NCC1-9)

(NASA-CR-164833) Avail: NTIS HC A02/MF A01 CSCL 01A

Accomplishments in vortex flap research are summarized. A singular feature of the vortex flap is that, throughout the range of angle of attack range, the flow type remains qualitatively unchanged. Accordingly, no large or sudden change in the aerodynamic characteristics, as happens when forcibly maintained attached flow suddenly reverts to separation, will occur with the vortex flap. Typical wind tunnel test data are presented which show the drag reduction potential of the vortex flap concept applied to a supersonic cruise airplane configuration. The new technology offers a means of aerodynamically augmenting roll-control effectiveness on slender wings at higher angles of attack by manipulating the vortex flow generated from leading edge separation. The proposed manipulator takes the form of a flap hinged at or close to the leading edge, normally retracted flush with the wing upper surface to conform to the airfoil shape. A.R.H.

N81-32118# National Aerospace Lab., Tokyo (Japan).

ON THE SPANWISE UNIFORMITY OF WIND TUNNEL TEST DATA OF TRANSONIC AIRFOILS

Tadashi Ito, Kooichi Suzuki, and Nobuhiko Kamiya 1981 46 p refs In JAPANESE; ENGLISH summary (NAL-TR-665; ISSN-0389-4010) Avail: NTIS

HC A03/MF A01

For flows of free stream Mach numbers below the drag divergence Mach number, the spanwise uniformity of the section drag coefficient is good in the region around the center section. Although the spanwise uniformity is bad for flows of freestream Mach numbers above that, the drag divergence Mach number can be obtained accurately. In order to improve the spanwise uniformity of the section drag coefficient, it would be necessary to survey the wake at a station close to the trailing edge rather than at a station 1-3 chords downstream of the trailing edge, as was done in this experiment. The spanwise uniformity of pressure distribution and of section lift coefficient is fairly good in the region around the center section. The spanwise uniformity is better at Mach numbers below M sub CD than at Mach numbers above M sub CD. T.M.

N81-32119*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

EFFECT OF SWEEP AND ASPECT RATIO ON THE LONGITUDINAL AERODYNAMICS OF A SPANLOADER WING IN AND OUT OF GROUND EFFECT

Scott O. Kjeldgaard and John W. Paulson, Jr. Jun. 1981 166 p refs Revised

(NASA-TM-80199) Avail: NTIS HC A08/MF A01 CSCL 01A

A wind tunnel investigation was conducted in the Langley 4 by 7 meter tunnel to determine the effects of leading edge sweep, aspect ratio, flap deflection, and elevon deflection on the longitudinal aerodynamic characteristics of a span distributed load advanced cargo aircraft (spanloader). Model configurations consisted of leading edge sweeps of 0, 15, 30 and 45 deg and aspect ratios of approximately 2, 4, 6, and 8. Data were obtained for angles of attack of -8 to 18 deg out of ground effect and at angles of attack of -2, 0, and 2 deg in ground effect at Mach number equal 0.14. Flap and elevon deflections ranged from -20 to 20 deg. The data are represented in tabulated form. M.G.

N81-32121*# George Washington Univ., Washington, D.C. School of Engineering and Applied Sciences.

PROGRAM OF RESEARCH IN LAMINAR FLOW CONTROL IN THE JIAFS AT NASA LANGLEY RESEARCH CENTER Status Report, 1 Jan. - 30 Jun. 1981

W. Pfenniger 30 Jul. 1981 15 p ref

(Grant NsG-1585)

(NASA-CR-164843) Avail: NTIS HC A02/MF A01 CSCL 01C

At high Reynolds numbers, the performance of a low drag suction LFC airplane is essentially controlled by the induced drag and the turbulent friction drag of the nonlaminarized area. The question then arises as to how the airplane cruise lift to drag ratio (L/D) sub cruise) cruise increases with increasing extent of laminar flow 0 sub lam./0 sub total (0 = airplane wetted area). In particular, the question arises as to the airplane performance in the optimum case with all laminar flow over the airplane wetted area. Design approaches of all laminar flow LFC airplanes which optimize the airplane range $R = \eta \text{ sub } 0 / W \text{ sub } 0 \text{ times } (L/D) \text{ times } H \text{ times } \lambda \text{ n}$ (W sub 0/W sub E) are considered. A.R.H.

N81-32124# ARO, Inc., Arnold Air Force Station, Tenn.

STING INTERFERENCE EFFECTS ON THE STATIC DYNAMIC AND BASE PRESSURE MEASUREMENTS OF THE STANDARD DYNAMICS MODEL AIRCRAFT AT MACH NUMBERS 0.3 THROUGH 1.3 Final Report, Jun. - Dec. 1980

Fred B. Cyran AEDC Aug. 1981 66 p refs Sponsored by the AF

(AD-A102612; AEDC-TR-81-3)

Avail: NTIS

HC A04/MF A01 CSCL 20/4

Wind tunnel tests were conducted in the Arnold Engineering Development Center (AEDC) Propulsion Wind Tunnel Facility (PWT) to provide sting-support interference information for planning and directing wind tunnel tests at subsonic and transonic Mach numbers. Sting length and diameter effects on static and dynamic stability derivatives, static pitching moments, and base pressure of the Standard Dynamics Model (SDM) were investigated at Mach numbers from 0.3 to 1.3. Dynamic stability derivatives were obtained at a nominal frequency of 5.2 Hz, at amplitudes of 1.0, 1.5, and 2.0 deg. Pitch and yaw data were both obtained as a function of angle of attack. Previously unpublished static force and moment data for the SDM are also presented. The results showed that interference related to sting length was most pronounced at Mach number 0.95 for all measurements; the results also showed significant effects at Mach numbers 1.1 and 1.3 for yaw damping. Substantial sting diameter effects were observed at Mach number 0.3 for pitch damping and at Mach number 1.3 for yaw damping. Both sting length and diameter effects were found in base-pressure measurements at most Mach numbers. Author (GRA)

N81-32128# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

INVESTIGATION OF THE CIRCULATION CONTROL WING/UPPER SURFACE BLOWING HIGH-LIFT SYSTEM ON A LOW ASPECT RATIO SEMISPAN MODEL Final Report, Aug. - Sep. 1980

Michael J. Harris May 1981 85 p refs

(WF41421000)

(AD-A103090; DTNSRDC/ASED-81/10)

Avail: NTIS

HC A05/MF A01 CSCL 20/4

The results from one in a series of investigations undertaken to develop the Circulation Control Wing/Upper Surface Blowing (CCW/USB) high-lift concept are presented. Included are: isolation of propulsion jet turning, effects of tip devices, and thrust reversing. As evaluated, the concept employs a modified supercritical wing with a 3.6-percent chord circular trailing edge and tangential blowing from a thin, full-span slot over this trailing edge. In addition, turbofans are mounted over the wing so that the exhaust scrubs the upper surface of the wing and is turned by the trailing edge. Unlike other upper surface blowing concepts, thrust deflection is accomplished by entraining the propulsive jet with tangential blowing around the trailing edge. The propulsive-induced lift enhances the proven high lift of the circulation control wing. For a thrust coefficient of 3.76, a tangential blowing coefficient of 0.24, and an angle of attack of 16 deg, the low aspect ratio model produced an untrimmed lift coefficient of 6.5. The system also demonstrated the capability to be used as an effective thrust reverser for deceleration during the landing ground roll. Author (GRA)

N81-32130# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
PROCEDURAL HANDBOOK FOR ESCAPE SYSTEM/ACCIDENT INVESTIGATION HELMET USAGE ASPECTS, INCLUDING FAILURE ANALYSIS Final Report
 Robert Snyder 20 May 1981 21 p
 (AD-A102803: NADC-81066-60) Avail: NTIS HC A02/MF A01 CSCL 06/7

Aircrew protective helmets are currently developed to reduce the severity of head impact injuries. Many helmets involved in ejections and land and water crashes may provide clues concerning the sequence of events immediately prior to and/or during the accident. Helmet design may have been a factor in the serious and sometimes fatal injuries sustained during these accidents. This handbook will describe a systematic analysis of aircrewman's helmets involved in accidents or ejections. This analysis may identify and recognize design weaknesses and result in the initiation of appropriate effective remedial action. Author (GRA)

N81-32131# Technische Universitaet, Brunswick (West Germany). Lehrstuhl fuer Flugmechanik.
TAKEOFF AND MISSED APPROACH UNDER THE INFLUENCE OF WIND SHEAR [START UND DURCHSTART UNTER SCHERWINDEINFLUSS]
 Reinhard Koenig and Peter Krauspe May 1980 27 p refs In GERMAN
 (TUBS/SFB-58-80-05-01) Avail: NTIS HC A03/MF A01

The effect of wind shear on flight performance and flight safety is examined. Loads on aircraft surfaces are quantized. Statutory regulations that concern takeoff and missed approach are considered. The effects of wind shear on takeoff, specifically regarding a missed approach to glide path, are then discussed. Air traffic control measures in consideration of wind shear are proposed. Author (ESA)

N81-32133# Radio Technical Commission for Aeronautics, Washington, D. C.
MINIMUM OPERATIONAL PERFORMANCE STANDARDS FOR MICROWAVE LANDING SYSTEM (MLS) AIRBORNE RECEIVING EQUIPMENT
 17 Jul. 1981 118 p
 (RTCA/DO-177) Avail: NTIS HC A06/MF A01

Describes characteristics, typical applications, and operational goals envisioned for microwave landing systems are described (MLS). Minimum performance standards for the airborne MLS receiving equipment are given. These standards define the required receiver performance under standard and environmental conditions and detail recommended test procedures to ensure compliance. Tests are included where performance cannot be adequately determined by bench tests. J.M.S.

N81-32136# Fondazione Ugo Bordoni, Rome (Italy).
CHARACTERISTICS OF A DIGITAL FILTER FOR A PRECISION DME SYSTEM IN MICROWAVE LANDING SYSTEMS [CARATTERISTICHE DI UN FILTRO DIGITALE APPLICATO AL SISTEMA DME DI PRECISIONE PER MLS]
 Franco Vatalaro Sep. 1980 40 p refs In ITALIAN
 (FUB-43-1980) Avail: NTIS HC A03/MF A01

The filter is placed onboard the aircraft as a last processing stage before the data are presented to the pilot. The filter is of the type alpha minus beta, used in radar applications. Errors were analyzed, distinguishing three different regions of the power spectrum: path following error; control motion noise; and high frequency noise. The precision requirements for conventional takeoff and vertical takeoff were examined. The parameters of the proposed filter, bandwidth and frequency response are given. Bendix is also described and comparison shows advantages and disadvantages in both designs. Final specifications by international authorities have been published. Author (ESA)

N81-32137*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A FULL-SCALE WIND TUNNEL INVESTIGATION OF A HELICOPTER BEARINGLESS MAIN ROTOR
 William Warmbrodt and John L. McCloud, II Aug. 1981 287 p
 (NASA-TM-81321: A-8696) Avail: NTIS HC A13/MF A01 CSCL 01C

A helicopter bearingless main rotor was tested. Areas of investigation included aeroelastic stability, aerodynamic performance, and rotor loads as a function of collective pitch setting,

RPM, airspeed and shaft angle. The rotor/support system was tested with the wind tunnel balance dampers installed and, subsequently, removed. Modifications to the rotor hub were tested. These included a reduction in the rotor control system stiffness and increased flexbeam structural damping. The primary objective of the test was to determine aeroelastic stability of the fundamental flexbeam/blade chordwise bending mode. The rotor was stable for all conditions. Damping of the rotor chordwise bending mode increases with increased collective pitch angle at constant operating conditions. No significant decrease in rotor damping occurred due to frequency coalescence between the blade chordwise fundamental bending mode and the support system. R.C.T.

N81-32138*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.
SOLAR POWERED AIRCRAFT Patent Application
 William H. Phillips, inventor (to NASA) Filed 15 May 1981 12 p
 (NASA-Case-LAR-12615-1: US-Patent-Appl-SN-263829) Avail: NTIS HC A02/MF A01 CSCL 01C

A cruciform wing structure for a solar powered aircraft is described. Solar cells are mounted on horizontal wing surfaces. Wing surfaces with spanwise axis perpendicular to the horizontal surfaces maintain these surfaces normal to the Sun line by allowing the aircraft to be flown in a controlled pattern at a large bank angle. The solar airplane may be of conventional design with respect to fuselage, propeller and tail, or may be constructed around a core and driven by propeller mechanisms attached near the tips of the airfoils. NASA

N81-32140# ARO, Inc., Arnold Air Force Station, Tenn. Directorate of Technology.
CAPTIVE AIRCRAFT TESTING AT HIGH ANGLES OF ATTACK Final Report, Oct. 1976 - Sep. 1978
 R. W. Butler and J. P. Christopher AEDC Aug. 1981 42 p refs
 (AD-A103108: AEDC-TR-80-60) Avail: NTIS HC A03/MF A01 CSCL 20/4

A captive testing technique capable of simulating aircraft maneuvers at high angles of attack has been developed and tested in the Aerodynamic Tunnel 16T of the Arnold Engineering Development Center (AEDC). The captive technique uses a closed loop system between wind tunnel, model, and computer. Use of the wind tunnel as an analog forcing function eliminates the requirement for a conventional static data matrix in motion simulation. Various high angle-of-attack maneuvers (rudder roll, aileron roll, wind-up turn, etc.) were generated with the captive system and show good correlation with flight data. Author (GRA)

N81-32141# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
TWIN-ROTOR PATROL AIRSHIP FLYING MODEL DESIGN RATIONALE
 John A. Eney 1 Jun. 1981 14 p
 (AD-A102575: NADC-81165-60) Avail: NTIS HC A02/MF A01 CSCL 01/3

To gain experimental data on the controllability of tilt-rotor airships operating near neutral buoyancy, a 32-foot long 1/10 scale flying model is being developed using two contrarotating tilt-rotor representing those on the NASA/Bell XV-15 research aircraft. It is planned to demonstrate controlled hover and transition in an engine-out condition with one rotor stopped to emphasize the natural attitude stability and damping of such vehicles. Author (GRA)

N81-32142# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.
DEVELOPMENT OF AN AIRCRAFT MANEUVER LOAD SPECTRUM BASED ON VGH DATA Final Report
 John W. Lincoln Jul. 1980 90 p
 (AD-A102750: ASD-TR-80-5037) Avail: NTIS HC A05/MF A01 CSCL 01/3

This report describes a procedure whereby a full scale aircraft maneuver load fatigue spectrum can be developed from recorded VGH data. It is assumed in this development that the internal loads (stresses) at the appropriate control points are available for combinations of velocity, load factor, altitudes and weight so that an interpolation on these points will provide the desired accuracy. The procedure will generate (for a control point) the cumulative probability of exceeding a given stress, exceedances

per hour of a given stress level, the probability density function for stress and the stress spectrum. The aircraft spectrum is derived from the assumption that the aircraft test loads derived from a linear combination of balanced loading conditions will provide a good simulation of the stress history at and 'between' the control points. The application of the program to new designs (mission analysis) and to tracking can be made without modification. The computer program for this calculation is included along with a sample problem. As an example of an application of this program, the stress exceedance functions for a control point on the wing of the F-4 are shown that were computed from the VGH data accumulated over a period of one year. Author (GRA)

N81-32143* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

SOFTWARE SURVEY FOR THE AVIONICS TEST BED Interim Report

J. M. Cobb Jul. 1981 113 p

(Contract NAS9-15800)

(NASA-CR-161089; JSC-17490; LEMSCO-16941) Avail: NTIS HC A06/MF A01 CSCL 01D

A survey was conducted to itemize software programs that could possibly be used in the development of an avionics test bed for shuttle attached or autonomous large space structures. The results of this survey are presented. Each program is described on a standard form J.M.S.

N81-32144* Arinc Research Corp., Annapolis, Md.

COST BENEFIT AND FAILURE CRITICALITY ANALYSES OF THE STANDARD AVIONICS INTEGRATED CONTROL SYSTEM (SAICS) CONCEPT

E. Straub, D. Godwin, and A. Savisaar Jun. 1981 129 p

(Contract F04606-79-G-0082; AF Proj. 2257)

(AD-A102197; Rept-2258-02-1-2439) Avail: NTIS HC A07/MF A01 CSCL 09/5

This document reports on the existing individual and integrated avionics cockpit controls of contemporary aircraft. Through failure-criticality and cost-benefit analyses, it examines the potential of a Standard Avionics Integrated Control System (SAICS) as a replacement for existing individual controls. The report provides information on existing individual cockpit avionics control mean times between failures (MTBFs), costs, weights, and sizes. It also provides MTBF, cost, space, and weight estimates for a unique integrated control, a standard avionics integrated control, and a manual back-up control panel for both. The study addresses primarily hardware, not software, and places emphasis on avionics control rather than display. It is assumed that installation of a SAICS would begin in five candidate tactical aircraft some time after 1985. Author (GRA)

N81-32147* Avco Lycoming Div., Stratford, Conn.

DESIGN AND EVALUATION OF AN INTEGRATED QUIET, CLEAN GENERAL AVIATION TURBOFAN (QCGAT) ENGINE AND AIRCRAFT PROPULSION SYSTEM Contractor Report, Dec. 1976 - Apr. 1980

Jon German, P. Fogel, and C. Wilson Apr. 1980 226 p refs (Contract NAS3-20584)

(NASA-CR-165185; LYC-80-27)

Avail: NTIS HC A11/MF A01 CSCL 21E

The design was based on the LTS-101 engine family for the core engine. A high bypass fan design (BPR=9.4) was incorporated to provide reduced fuel consumption for the design mission. All acoustic and pollutant emissions goals were achieved. A discussion of the preliminary design of a business jet suitable for the developed propulsion system is included. It is concluded that large engine technology can be successfully applied to small turbofans, and noise or pollutant levels need not be constraints for the design of future small general aviation turbofan engines. T.M.

N81-32150* Tennessee Univ. Space Inst., Tullahoma.

UNSTEADY SWIRLING FLOWS IN GAS TURBINES Annual Technical Report, 1 Apr. 1980 - 30 Jun. 1981

M. Kurosaka Jun. 1981 51 p

(Contract F49620-78-C-0045; AF Proj. 2307)

(AD-A102852; AFOSR-81-0608TR) Avail: NTIS

HC A04/MF A01 CSCL 21/5

This annual report covers the second phase of investigations into the unsteady swirling flows. The overall objective of the entire program is to acquire fundamental understanding of a phenomenon characterized by violent fluctuations occurring in

swirling flows in gas turbines; this flow instability, dubbed here as 'Vortex Whistle' is known to be capable of causing severe fatigue failure in gas turbine components. Although the phenomena of 'Vortex Whistle' have never remained unrecognized, perhaps for the reason that they appeared in seemingly unrelated incidents under various disguise, no comprehensive investigation appears to have been embarked upon. In addition, in spite of the fact that the vortex whistle is a pure tone noise and distinctly audible, its role as a source of aircraft engine noise has never been recognized. Furthermore, when the vortex whistle becomes intense, it induces a change in the steady flow field, the total temperature being spontaneously separated in the radial direction (the Ranque-Hilsch effect). Not only its implications to the study aero design of turbomachines are of obvious importance, but also this appears to offer an unmistakable clue to the puzzling Ranque-Hilsch effect. GRA

N81-32151* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

FLIGHT EVALUATION OF THE STOL FLARE AND LANDING DURING NIGHT OPERATIONS

James A. Franklin, Robert C. Innis, and Gordon H. Hardy Aug. 1981 46 p refs

(NASA-TM-81312; A-8704) Avail: NTIS HC A03/MF A01 CSCL 01C

Simulated instrument approaches were made to Category 1 minimums followed by a visual landing on a 100 x 1700 ft STOL runway. Data were obtained for variations in the aircraft's flare response characteristics and control techniques and for different combinations of aircraft and runway lighting and a visual approach slope indication. With the complete aircraft and runway lighting and visual guidance no degradation in flying qualities or landing performance was observed compared to daylight operations. Elimination of the touchdown zone floodlights or the aircraft landing lights led to somewhat greater pilot workload; however, the landing could still be accomplished successfully. Loss of both touchdown zone and aircraft landing lights led to a high workload situation and only a marginally adequate to inadequate landing capability. T.M.

N81-32152* Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

THE CONTROL ANTICIPATION PARAMETER FOR AUGMENTED AIRCRAFT Final Report, 1 Jan. - 15 May 1981

D. E. Bischoff 15 May 1981 40 p refs

(AD-A102626; NADC-81186-60) Avail: NTIS HC A03/MF A01 CSCL 01/3

A longitudinal control anticipation parameter is developed which correlates high order augmented aircraft dynamics with both lower order equivalent system descriptions and pilot opinion ratings. Three extensive in-flight research programs are analyzed via the developed parameter in an effort to define regions of pilot acceptability. Additional effort is recommended to verify the minimum level 1 boundaries and to determine the relationship between the control anticipation parameter and alternate proposed criteria. Author (GRA)

N81-32153* National Aeronautics and Space Administration, Washington, D. C.

WIND TUNNELS OF NASA

Donald D. Baals and William R. Corliss 1981 162 p Original document contains color illustrations

(NASA-SP-440) Avail: NTIS HC A08/MF A01 CSCL 14B

The contribution of wind tunnels to aerodynamic studies is described. The development of the wind tunnel and the problems of calibration, scaling, and instrumentation are discussed. The NASA wind tunnels form the basis for the book, but Air Force, university, and industrial facilities are also considered. T.M.

N81-32154* Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

TWO-DIMENSIONAL DYNAMIC STALL AS SIMULATED IN A VARYING FREESTREAM

G. Alvin Pierce, Donald L. Kunz, and John B. Malone 1978 67 p refs

(Grant NGR-11-002-185)

(NASA-CR-164829) Avail: NTIS HC A04/MF A01 CSCL 14B

A low speed wind tunnel equipped with a axial gust generator to simulate the aerodynamic environment of a helicopter rotor was used to study the dynamic stall of a pitching blade in an

effort to ascertain to what extent harmonic velocity perturbations in the freestream affect dynamic stall. The aerodynamic moment on a two dimensional, pitching blade model in both constant and pulsating airstream was measured. An operational analog computer was used to perform on-line data reduction and plots of moment versus angle of attack and work done by the moment were obtained. The data taken in the varying freestream were then compared to constant freestream data and to the results of two analytical methods. These comparisons show that the velocity perturbations have a significant effect on the pitching moment which can not be consistently predicted by the analytical methods, but had no drastic effect on the blade stability. A.R.H.

N81-32155# ARO, Inc., Arnold Air Force Station, Tenn.
SUPPLEMENTAL CALIBRATION OF THE AEDC-PWT 16 FT TRANSONIC TUNNEL AERODYNAMIC TEST SECTION Final Report, Dec. 1979 - Jun. 1980

M. L. Mills AEDC Jul. 1981 109 p refs Sponsored by the AF

(AD-A102384; AEDC-TR-80-32) Avail: NTIS HC A06/MF A01 CSCL 14/2

A test was conducted in the Propulsion Wind Tunnel (16T) to: (1) define the effect of plenum suction utilization on the tunnel calibration and power consumption at free-stream Mach numbers less than 0.75, (2) improve the centerline Mach number calibration at supersonic Mach numbers, (3) correlate the test section centerline Mach number with the tunnel nozzle Mach number, and (4) investigate the effect of tunnel humidity on the calibration. Data were acquired for Mach numbers from 0.6 to 1.6 at total pressures from 400 to 3,200 psfa. The calibration was conducted in the aerodynamic test section using a centerline pipe and wall pressure orifices to define the Mach number distributions. The results of an evaluation of alternate methods of calibration indicated that the current method is the most acceptable. Slightly changing the tunnel nozzle to eliminate the disturbances in the flow at supersonic Mach numbers indicated the need to investigate the entire nozzle system. Comparison of this calibration with previous calibration results indicates that a revision of the current tunnel calibration is not necessary.

Author (GRA)

N81-32156# Naval Civil Engineering Lab., Port Hueneme, Calif.
LIME-STABILIZED NATIVE SOIL AS BASE COURSE FOR LIGHT AIRCRAFT PAVEMENT Final Report, Feb. 1978 - Apr. 1981

Robert B. Brownie Apr. 1981 130 p refs (Contract DOT-FA78WAI-834)

(AD-A102196; FAA-RD-80-112) Avail: NTIS HC A07/MF A01 CSCL 13/2

Present Federal Aviation Administration policy does not recommend the use of lime stabilized soil as base course for airport pavements. The potential savings in cost and materials by using this type of construction for light duty airport pavements (aircraft gross weights less than 30,000 lbs) led to the use of lime stabilized native soil in place of other base course materials at three airports in the Southwestern United States. Those airports are located at Chino, California, Big Bear Lake, California, and Payson, Arizona. The compositions of those base courses were determined by laboratory analyses of core borings and soil samples. Visual condition surveys were performed, and surface deflections under load were measured. Climatological data and aircraft traffic histories were obtained. All of those factors and the performance of the pavements were analyzed, and a suggested specification was prepared for constructing lime stabilized base courses. GRA

N81-32158# Pacer Systems, Inc., Arlington, Va.
DEVELOPMENT OF A HELIPORT CLASSIFICATION METHOD AND AN ANALYSIS OF HELIPORT REAL ESTATE AND AIRSPACE REQUIREMENTS Final Report, Jan. - Jun. 1981

F. D. Smith and A. G. DeLucien Jun. 1981 100 p refs (Contract DOT-FA01-80-C-10080)

(AD-A102521; PAR-018-81; FAA-RD-81-35) Avail: NTIS HC A05/MF A01 CSCL 01/5

A helicopter performance related heliport classification method is developed which accommodates an applicable range of operating conditions and factors which impact helicopter performance. Dimensional values for use in planning both real estate and airspace surfaces are determined for application to the identified heliport classifications. Those values are incorporated

into generalized guidelines for heliport planners to meet site-specific and non-standard operational conditions. Requirements for flight manual performance charts and published heliport information are also identified. Author (GRA)

N81-32164# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.

DATA ACQUISITION AND ANALYSIS SYSTEM AS A TRAINING DEVICE FOR SIMULATED CONVENTIONAL WEAPON DELIVERY

C. F. G. M. Hofman and J. Batenburg (Royal Netherlands Air Force) 24 Jun. 1980 13 p refs Presented at AGARD Symp. on Subsystem Testing and Flight Test Instr., Geilo, Norway, 27-30 Oct. 1980 and at 2nd Interserv./Ind. Training Equipment Conf., Salt Lake City, 18-20 Nov. 1980

(NLR-MP-80027-U) Avail: NTIS HC A02/MF A01

The system, based on a photogrammetric method, yields release conditions, the nominal weapon impact position and the weapon time of flight. Simulated attacks on a great variety of realistic targets can be evaluated and validated as there is no need to drop training weapons. No ground-based instrumentation in the target area is needed. The system consisting of an airborne data acquisition system installed in the aircraft and a ground-based processing and analysis system at the airbase allows a debriefing of the pilot within half an hour after completion of the mission. Circular error probable during flight tests with a variety of weapons compared well with predictions. Airworthiness evaluations shows the equipment to be reliable and having no adverse effect on handling. Author (ESA)

N81-32273# Brookhaven National Lab., Upton, N. Y.
WATER-COMPATIBLE POLYMER CONCRETE MATERIALS FOR USE IN RAPID REPAIR SYSTEMS FOR AIRPORT RUNWAYS Final Report

T. Sugama, L. E. Kukacka, and W. Horn Mar. 1981 129 p refs

(Grant AFOSR ISSA 80-00027; AF Proj. 2307)

(AD-A102873; BNL-51390; AFOSR-81-0589TR) Avail: NTIS HC A07/MF A01 CSCL 01/5

Water-compatible polymer concrete (PC) formulations have been developed which appear to have potential for use in all-weather rapid repair procedures for bomb-damaged runways. Formulations consisting of furfuryl alcohol, water-saturated aggregate, dry silica flour, promoters, and catalysts produced composites with properties suitable for repair purposes when mixed and polymerized at temperatures from -20 to 30 C. Calcium-unsaturated polyester complexed PC also produced excellent properties. However, the early strength criteria, (2000 psi (13.78 MPa) at 1 hr) and other requirements such as compatibility of the formulation with water and practical working times could be attained only at temperatures >20 deg C. This system can be polymerized under water. Studies of the polymerization reaction mechanisms, materials properties, costs, and potential placement methods were performed. Author (GRA)

N81-32290# Energy and Minerals Research Co., Exton, Pa.
ULTRASONIC DISPERSION OF PARTICULATE HIGH DENSITY FUELS Final Report, Sep. 1979 - Sep. 1980

Wright-Patterson AFB, Ohio AFAL May 1981 44 p

(Contract F33615-79-C-2090; AF Proj. 3048)

(AD-A102771; AFAL-TR-81-2033) Avail: NTIS HC A03/MF A01 CSCL 21/4

The high energy-density slurry fuels being developed to increase missile range may present settling and gelation problems in use. This project was performed to demonstrate ultrasonic dispersion techniques, with the goal of deagglomerating to more uniform, smaller particle-size solids distribution and increased storage stability. Batch and continuous process laboratory-type arrays were used at various power levels (nominal 200 to 1000 watts), on carbon and boron/JP-10 slurries of interest to the Air Force. Analytical techniques, difficult with the particulate sizes involved (down to the 300-millimicron range), showed some measure of ultrasonic deagglomeration, which increased with increasing ultrasonic energy densities, and complete stability of the 60-day-storage activated samples, in contrast to the non-activated control samples. Extended analysis might better quantify ultrasonic effect, but combustion tests could directly identify performance benefits. GRA

N81-32522# Sacramento Air Materiel Area, McClellan AFB, Calif.

THE USE OF ACOUSTIC EMISSION FOR DETECTION OF ACTIVE CORROSION AND DEGRADED ADHESIVE BONDING IN AIRCRAFT STRUCTURE

John Rodgers and Steven Moore Nov. 1975 16 p refs
(AD-A102923; Paper-14) Avail: NTIS HC A02/MF A01 CSCL 01/3

Procedures have been developed by engineers at Sacramento Air Logistics Center to detect active corrosion in aluminum structure and moisture-degraded adhesive bonding in composite honeycomb using acoustic emission monitoring. Simple heating methods employing a hot air gun or heat lamp are used to increase emission from active corrosion sources, and to create the stresses necessary to break moisture-degraded adhesive bonds. Corrosion detection in aluminum skin and honeycomb core has proven very successful. Detection of moisture-degraded bonding between aluminum skin and phenolic core on the F-111 vertical stabilizer leading edge has been substantially improved and simplified. Acoustic emission is replacing X-ray and ultrasonic inspection procedures in these applications, with direct benefits realized in a 75% reduction of inspection time and costs, fewer work flow interruptions, and better defect area definition.

Author (GRA)

N81-32956*# California Univ., Los Angeles. School of Engineering and Applied Science.

FORECAST OF FUTURE AVIATION FUELS: THE MODEL Final Report

M. B. Ayati, C. Y. Liu, and J. M. English Sep. 1981 192 p refs

(Contract NSG-3116)

(NASA-CR-165486; UCLA-eng-8037) Avail: NTIS HC A09/MF A01 CSCL 12B

A conceptual models of the commercial air transportation industry is developed which can be used to predict trends in economics, demand, and consumption. The methodology is based on digraph theory, which considers the interaction of variables and propagation of changes. Air transportation economics are treated by examination of major variables, their relationships, historic trends, and calculation of regression coefficients. A description of the modeling technique and a compilation of historic airline industry statistics used to determine interaction coefficients are included. Results of model validations show negligible difference between actual and projected values over the twenty-eight year period of 1959 to 1976. A limited application of the method presents forecasts of air transportation industry demand, growth, revenue, costs, and fuel consumption to 2020 for two scenarios of future economic growth and energy consumption.

Author

N81-32966*# National Aeronautics and Space Administration Langley Research Center, Hampton, Va.

USER'S MANUAL FOR A COMPUTER PROGRAM TO CALCULATE DISCRETE FREQUENCY NOISE OF CONVENTIONAL AND ADVANCED PROPELLERS

R. M. Martin and F. Farassat Aug. 1981 90 p refs
(NASA-TM-83135; L-14374) Avail: NTIS HC A05/MF A01 CSCL 20A

A user's manual is presented for a computer program for the calculation of discrete frequency noise of conventional and advanced propellers. The structure of the program and the subroutines describing the input functions are discussed. Input variables and their default values and the variables in the output data sheet are defined. Two versions of the program are available. These differ only in the graphic output capability. One version has only printed output capability. A second version with extensive graphic output capability is available for the computer system at Langley. This Manual includes four detailed examples of both the printed and graphic outputs. These examples may be reproduced by users to check their code on their computer system.

A.R.H

N81-33131# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

DESIGN OF OPTIMAL INPUTS FOR THE IDENTIFICATION OF CHARACTERISTICS OF AIRCRAFT FLIGHTS [ENTWURF VON EINGANGSSIGNALLEN FUER DIE KENNWERTERMITTLUNG BEI FLUGZEUGEN]

E. Plaetschke In Hochschule der Bundeswehr Seminar on the

Simulation and Optimization of Dyn. Systems Jun. 1981 p 102-120 refs

Avail: NTIS HC A08/MF A01

The design of optimal inputs for identifying stability and control derivatives of the longitudinal and lateral motion of an aircraft are considered. Two different procedures of input design were treated in more detail. Starting with investigations in the frequency domain, the first method yields a multistep input signal, which fulfills specific spectral requirements. Compared with the power spectral densities of the commonly used double and single step input, this multistep input has a larger bandwidth. The second method is based on the optimization of different measures of the Fisher information matrix, such as determinant or trace. Depending on the measure used, the designed signals differ with respect to their spectral composition. The discussed input signals, which were used in a flight test program, are compared with respect to the achieved accuracy of the identified stability and control derivatives.

Author (ESA)

N81-33132# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.

SYSTEM IDENTIFICATION FOR CONTROLLED AIRCRAFT [SYSTEMIDENTIFIZIERUNG AM GEREGETEN FLUGZEUG]

M. Marchand In Hochschule der Bundeswehr Seminar on the Simulation and Optimization of Dyn. Systems Jun. 1981 p 121-166 refs In GERMAN

Avail: NTIS HC A08/MF A01

The problems and experiences in applying a maximum likelihood identification method to the flight test data of a controller-supported aircraft are reported. The effect of the controller on the identifiability of the parameters and the validity of the model structure of a so-called equivalent system are treated. The role of the pilot in the control loop, e.g., with respect to stability, and the identification of pilot models is addressed.

Author (ESA)

N81-33133# RAND Corp., Santa Monica, Calif.

ESTIMATING AIRCRAFT DEPOT MAINTENANCE COSTS Interim Report

Kenneth E. Marks and Ronald W. Hess Jul. 1981 214 p

(Contract MDA903-77-C-0107)

(AD-A103623; RAND/R-2731-PA/E) Avail: NTIS HC A10/MF A01 CSCL 05/1

This report describes a series of parametric equations for use in estimating the depot maintenance cost of new Air Force aircraft, particularly for the five major maintenance categories: airframe rework, engine overhaul, airframe component repair, engine component and accessory repair, and avionics component repair. The equations are intended to provide cost estimates for Defense Systems Acquisitions Review Council Milestone II, at which point some design details of major aircraft subsystems (airframes, engine avionics) are available. The report presents a single set of equations that are the most representative and applicable to the widest range of estimating situations, but presents alternative equations and supporting data and analyses.

Author (GRA)

N81-33134# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A STUDY OF THE FACTORS AFFECTING PRODUCTIVITY AT THE NAVAL AIR REWORK FACILITIES M.S. Thesis

Janice Allton and Stephen N. Bernard Jun. 1981 83 p refs
(AD-A103783; AFIT-LSSR-10-81) Avail: NTIS

HC A05/MF A01 CSCL 05/1

The purpose of this study was to determine the factors affecting productivity at Naval Air Rework Facilities (NARFs). Specific points addressed were number and identity of factors, internal consistency and usefulness in predicting perceived productivity. A seventy-two item questionnaire was administered to a random sample of NARF production-line employees. Five hundred thirty-four cases were factor analyzed. Eleven factors extracted were discussed. Eight of these were used to develop a linear multiple regression model to predict perceived productivity. Approximately twenty percent of the variance in perceived productivity was predicted, with five independent variables (factors) work scheduling supervision, overtime, training quality and equipment. These factors generally substantiated those found in current literature.

Author (GRA)

N81-33135# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics.

A PRESCRIPTIVE MODEL FOR RESOURCE ALLOCATION AT THE INTERMEDIATE LEVEL ENGINE FACILITY
M.S. Thesis

Edward Connolly and Charlie D. Johnson Jun. 1981 91 p refs
(AD-A103785; AFIT-LSSR-26-81) Avail: NTIS
HC A05/MF A01 CSCL 15/5

Inability to support spare engine requirements has a critical impact on this nation's ability to meet its worldwide commitments during a crisis. This study examined those factors that significantly affect the intermediate level Propulsion Branch's ability to provide a steady supply of spare engines. Through simulation modeling and analysis, four factors were identified as driving the Base Repair Cycle time: spare parts, repair equipment, manpower, and experience level. A decision support system was developed which enables most users to assess the influence on repair cycle time of additional funding levels in specific factor areas.

Author (GRA)

N81-33136# Boeing Aerospace Co., Seattle, Wash. Product Support/Experience Analysis Center.

DEVELOPMENT OF MAINTENANCE METRICS TO FORECAST RESOURCE DEMANDS OF WEAPON SYSTEMS Final Report, 1 Mar. 1978 - 1 Oct. 1980

Donald K. Hindes, Gary A. Walker, and David H. Wilson Wright-Patterson AFB, Ohio Air Force Human Resources Lab. Oct. 1980 154 p refs

(Contract F33615-77-C-0075)
(AD-A104089; D194-10089-5) Avail: NTIS
HC A08/MF A01 CSCL 05/1

This report describes the methodology and results of a 32 month effort to 'Develop Maintenance Metrics To Forecast Resource Demands of Weapon Systems'. Increased concern with the rising cost to support weapon systems currently in operation, as well as those in development, has created the need for more accurate methods of projecting maintenance requirements. The objective of this subject research was to alleviate the above need by identifying, determining, and integrating those measurable weapon system parameters which are necessary and sufficient to predict and quantify the drivers of maintenance resource demands. Phase 1 investigated and developed new maintenance metrics for aircraft propulsion and avionics. Phase 1 results were then reviewed for overall success and applicability before proceeding with Phase 2 efforts. Initial results were acceptable so Phase 2 of the study was initiated to develop metrics for the rest of the subsystems commonly included in Air Force aircraft. This document is the final report of a series of five technical reports published during the study. It is intended to be a summary overview of the study project and an application guide for potential users of the developed metrics methodology. Study findings include: (1) Review of published literature; (2) Critical equipment selection; (3) Maintenance impact parameter identification; (4) Data base assembly and integration; (5) Maintenance impact estimating relationship detection and analysis; (6) Maintenance metric model development; and (7) Maintenance metrics validation. GRA

N81-33137# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

THE IMPACT OF MILITARY APPLICATIONS ON ROTORCRAFT AND V/STOL AIRCRAFT DESIGN

Jun. 1981 264 p refs In ENGLISH and FRENCH Conf. held at Paris, 6-9 Apr. 1981

(AGARD-CP-313; ISBN-92-835-0294-9) Avail: NTIS
HC A12/MF A01

The technological status of rotorcraft and V/STOL aircraft were reviewed in light of operational possibilities and needs. Topics include operational experiences, present status of technology, future trends, and military mission effectiveness.

N81-33138# French Army, Villacoublay-Air (France).
INCIDENTS OF PROBLEMS IN SETTING TO WORK ON THE CONCEPTUAL DESIGN OF HELICOPTERS [INCIDENCES DES PROBLEMES DE MISE EN OEUVRE SUR LA CONCEPTION DES HELICOPTERES]

M. G. Cagnet In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 12 p In FRENCH

Avail: NTIS HC A12/MF A01

The problems focused on concern only the development and design of military helicopters. The general operational requirements of today's military helicopter were reviewed. The immediate problems facing the helicopter industry are discussed. Technological forecasts for the next 20 years are presented with emphasis on the direction that research management will take in helicopter design. T.M.

N81-33139# Martin Marietta Aerospace, Bethesda, Md.
VERTICAL LIFT CAPABILITIES FOR THE 80'S AND 90'S
Norman R. Augustine and James B. Morrison In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 16 p

Avail: NTIS HC A12/MF A01

During the past few years, several things have happened to make vertical lift more attractive. The first is that the technologies in engines, structures, stability and control and avionics have all been improving rapidly, producing great strides in performance, maintainability and potential cost reduction. The second is that the facts of operational life have changed to put additional value on vertical takeoff and landing capability. The status of battlefield vertical lift systems in the United States in reference to the level of technology, mission capabilities and associated development activities is reported. Also, projections in each of these areas are presented, accompanied by a list of recommendations based on the perceived pitfalls in the past and the technological and mission opportunities of the future. T.M.

N81-33140# Marine Corps, Washington, D. C.
TEN YEARS OF US MARINE CORPS HARRIER OPERATIONS

R. A. Gustafson In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 p 10

Avail: NTIS HC A12/MF A01

The VSTOL concept is exceptionally attractive to the Marine Corps because of the significant benefits to expeditionary capability and reduced close air support response times made possible through basing flexibility. The AV-8A was employed world-wide by the Marine Corps aboard ship and ashore. Although the primary purpose of the AV-8A is to provide close air support to the Marine ground combat element, the thrust-vectoring design of the Harrier proved to have significant potential in air combat maneuvering. Operations with the AV-8A highlight areas where future VSTOLs should be improved as well as providing an experience base to support their design. This operational experience proves the VSTOL concept, and the Marine Corps is convinced that significantly increased combat effectiveness is provided. To further expand the VSTOL application, the Marine Corps plans to replace its present eight light attack squadrons with an improved Harrier, the AV-8B. The long term goal is to achieve an all VSTOL aviation force. T.M.

N81-33141# Army Aviation Center, Fort Rucker, Ala.
FIELDING OF AN ADVANCED HELICOPTER, THE UH-60A BLACK HAWK: INITIAL OPERATIONAL EXPERIENCE

Cornelius F. McGillicuddy, Jr. In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 10 p

Avail: NTIS HC A12/MF A01

The Sikorsky UH-60A was developed and designed to replace the UH-1H Iroquois for assault, air cavalry, and aeromedical evacuation missions. The UH-60A carries the infantry squad of 11 men and their equipment as a basic load. Particular emphasis during development was devoted to reducing vulnerability, improving crashworthiness and maintainability. There are eight separate kits for the basic aircraft which increase mission flexibility. The development of the UH-60A was highly successful as have the initial operational experiences. The Black Hawk was issued to operational units and these units deployed and engaged in field exercises both in and outside of the United States. The lessons derived from these operational experiences will assist in improving the UH-60A and defining roles for future utility aircraft. T.M.

N81-33142# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
VIEWS ON V/STOL TACTICAL FIGHTER AIRCRAFT: TECHNOLOGY NEEDS AND RELATIONSHIPS TO THE RUNWAY DENIAL PROBLEMS

John M. Byrnes, G. Keith Richey, and Randall B. Lowry / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 13 p refs

Avail: NTIS HC A12/MF A01

On the basis of a number of studies conducted over the past three or four years, the Air Force technology community developed an intense concern over the vulnerability of USAF airbases, particularly those in Central Europe. For this reason, advanced concepts which may help solve the problem in the near and far terms are addressed. A possible airbase survivability plan is presented, and the pros and cons of STOL versus V/STOL aircraft, as a far term solution, are discussed. T.M.

N81-33143* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

HISTORICAL OVERVIEW OF V/STOL AIRCRAFT TECHNOLOGY

Seth B. Anderson / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 13 p

Avail: NTIS HC A12/MF A01 CSCL 01B

During the past 25 years over 60 V/STOL types were studied and flown with varying degrees of success. The requirements for satisfactory characteristics in several key technology areas are discussed and a review is made of various V/STOL aircraft for the purpose of assessing the success or failure of each design in meeting design requirements. This survey shows that in spite of many problems revealed, special operating techniques were developed to help circumvent deficiencies. For the most part performance and handling qualities limitations restricted operational evaluations. Flight operations emphasized the need for good STOL performance, good handling qualities, and stability and control augmentation. The majority of aircraft suffered adverse ground effects. T.M.

N81-33144* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

RECENT PROGRESS IN V/STOL AIRCRAFT TECHNOLOGY

L. Roberts, W. Deckert, and D. Hickey / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 10 p refs

Avail: NTIS HC A12/MF A01 CSCL 01B

Recent results from wind-tunnel and flight-tests investigations for V/STOL aircraft were reviewed. Primary emphasis is given to technical results relating to three types of subsonic aircraft: a quiet STOL aircraft; a tilt rotor aircraft, and a turboprop V/STOL aircraft. Comparison and correlation between theoretical and experimental results, and between wind-tunnel and flight-test results, is made. The quiet STOL aircraft technology results are primarily those derived from the NASA/Boeing Quiet Short Haul Aircraft (QSRA) program. The tilt rotor aircraft technology results are those obtained from the NASA/Army/Navy/Bell (XV-15-TRRA) aircraft flight investigations. The turboprop V/STOL aircraft technology results are from static ground facility and wind-tunnel investigations of a NASA/Navy/Grumman full-scale lift/cruise fan aircraft model, which features two tilting nacelles with TF-34 engines. T.M.

N81-33145* Messerschmidt-Boelkow G.m.b.H., Munich (West Germany). Helicopter Div.

CONTROLS AND DISPLAYS FOR ALL-WEATHER OPERATION OF HELICOPTERS

R. D. vonReth / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 15 p refs

Avail: NTIS HC A12/MF A01

Various mission requirements for all weather operations were reviewed. In particular some of the most important features for military applications are outlined. Some of the basic relations between increasing display sophistication and increasing control sophistication are discussed. Also the influence of various functions on the degree of control automation as it seems desirable for future systems under the aspect of man-machine interaction are taken into consideration. In a comparison the controls and displays arrangement of some representative helicopters of presently operational helicopters are described. An outline of the goals and results of some experimental and research programs is given. The characteristics of presently operational helicopters are compared with the technologically feasible solutions taking into

account some of the economic constraints as initial cost, operational cost and reliability. Future basic requirements for the controls and the displays operation are established. T.M.

N81-33146* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

THE ROLE OF THE RESEARCH SIMULATOR IN THE SYSTEMS DEVELOPMENT OF ROTORCRAFT

Irving C. Statler and Arlin Deel / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 21 p refs Prepared in cooperation with Army Aviation Research and Development Command, Moffett Field, Calif.

Avail: NTIS HC A12/MF A01 CSCL 14B

Over the last 20 years, flight simulators became widely accepted as training tools. Moreover, research simulators were used extensively by the fixed-wing industry: in the design, testing, and certification of new aircraft. The rotorcraft industry, however, was slow to use man-in-the-loop simulation to solve its design problems, primarily because of the difficulty of modeling complex rotorcraft for realtime simulation and because of the need for a wide-angle visual system for low-level flight. A joint U.S. Army and NASA program was initiated to provide this simulation capability for exploitation by both government and industry. The potential application of the research simulator to future rotorcraft systems design, development, product improvement evaluations, and safety analysis is discussed. T.M.

N81-33147* Societe Nationale Industrielle Aerospatiale, Marignane (France.)

APPLICATIONS OF COMPOSITE MATERIALS FOR THE CONSTRUCTION OF MILITARY HELICOPTERS [APPLICATIONS DES MATERIAUX COMPOSITES POUR LA CONSTRUCTION D'HELICOPTERES MILITAIRES]

A. Sourdon and G. Beziac / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 21 p refs In FRENCH

Avail: NTIS HC A12/MF A01

Production costs and versatility of the construction materials are the guiding factors for aircraft construction techniques. The ever increasing use of composite materials in aircraft construction is a result of these factors. The utilization of composite materials in helicopter construction is discussed. Special emphasis is placed on the advantages and disadvantages of the use of these materials for military helicopters. T.M.

N81-33148* Institut fuer Flugmechanik, Brunswick (West Germany).

THE IMPACT OF HELICOPTER FLIGHT MECHANICS ON MISSION PERFORMANCE

B. L. Gmelin and H.-J. Pausder / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 14 p refs

Avail: NTIS HC A12/MF A01

In comparison to other VTOL aircraft, the helicopter has inherently superior flying characteristics at hover and in the low speed region but it has clear disadvantages by its lower high speed capability. For the completion of today's military helicopter missions near the ground and in all weather flight conditions a careful flight mechanical adaptation of the pilot-helicopter system to the specific task is required. This includes the combined optimization of the basic aircraft, the additional system equipment, and in a certain degree the pilot control behavior. A DFVLR-methodology is presented, having the objective to evaluate the flight mechanical characteristics of the pilot-helicopter system with regard to specific flight tasks. The method leads to taskoriented evaluation diagrams which include scales for the overall system task performance and for the demands on the pilot. Relevant flight test results of the BO 105 helicopter in hover and NOE-flight are presented. Especially the parameters control activity and task performance are discussed. Author

N81-33149* Rolls-Royce Ltd., Bristol (England).

MULTI-MISSION STOVL WITH VECTORED THRUST ENGINES

W. J. Lewis and P. Simplin (Rolls-Royce Ltd., Derby, England) / In AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 9 p

Avail: NTIS HC A12/MF A01

It is demonstrated how a single vectored thrust engine with plenum chamber burning on the front nozzles can be used in both a subsonic strike and a supersonic air superiority aircraft. The operational capability of the STOVL aircraft was compared with CTOL aircraft powered by an advanced turbofan of similar technology. It is also demonstrated that, when operated on the European environment, the STOVL aircraft when sized and operated in a manner which takes advantage of their specialized capabilities, have higher levels of mission effectiveness compared to the CTOL designs. Author

N81-33150# Textron Bell Helicopter, Fort Worth, Tex. Tilt Rotors.

MISSION POTENTIAL OF DERIVATIVES OF THE XV-15 TILT ROTOR RESEARCH AIRCRAFT

Kenneth G. Wernicke /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 9 p

Avail: NTIS HC A12/MF A01

Outstanding low- and high-speed performance and flight characteristics were demonstrated and measured on the XV-15 tilt rotor research aircraft. Although the XV-15 was designed specifically as a research vehicle, it has the potential, with suitable modifications, to evolve into a productive aircraft for other missions. An increase in blade chord and installation of current state-of-the-art engines increase payload and significantly reduce fuel consumption. A third engine is installed on top of the fuselage to provide good one-engine-inoperative performance. A new fuselage is used for gunship missions. Derivative aircraft and the required changes for commercial and military applications are described. It is shown that the XV-15 derivatives are competitive with existing aircraft. Some of the derivative aircraft can perform missions not possible with airplanes or helicopters by use of the unique high-speed/long-range VTOL capability and the highly-flexible flight envelope of the tilt rotor aircraft. Author

N81-33151# Sikorsky Aircraft, Stratford, Conn.

ADVANCING BLADE CONCEPT HELICOPTER MISSION CAPABILITIES

Robert Zincone and Arthur W. Linden /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 16 p

Avail: NTIS HC A12/MF A01

Today there are several ongoing research programs aimed at combining speed with helicopter attributes in a single vehicle. There is a growing recognition of a need for such aircraft and an active reexamination of the value of speed, the value of helicopter attributes (hover and low speed performance) and the trade-offs between these. Key attributes of interest to military users are: Battlefield survivability - ballistic, acoustic, radar cross section, IR signature; high speed flight while preserving low speed handling qualities equal to those of modern combat helicopters; compact design with low inertia, yielding high angular rates and precise control in all axes; high acceleration and deceleration capability; carrier and small ship compatibility, with good, low speed platform stability; superior one engine inoperative performance and safety; and field level maintainability with rugged reliability and maintainability attributes owing to simplicity of design. The Advancing Blade Concept helicopter has recently completed a feasibility demonstration phase showing that these attributes can be achieved in future aircraft designs. Author

N81-33152# De Havilland Aircraft Co. of Canada Ltd., Downsview (Ontario).

V/STOL AIRCRAFT TECHNOLOGY IN CANADA

D. C. Whittley /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 9 p refs

Avail: NTIS HC A12/MF A01

Some principles being applied to research in relation to advanced STOL and V/STOL concepts are described. In particular, consideration is given to the supercritical augmentor flap configuration and to a fuselage ejector-lift VTOL concept. L.F.M.

N81-33153# Societe Nationale Industrielle Aerospatiale, Marignane (France.)

THE CONSEQUENCES OF CERTAIN OPERATIONAL REQUIREMENTS ON THE CONCEPTUAL DESIGN OF COMBAT HELICOPTERS [LES CONSEQUENCES DE CERTAINES EXIGENCES OPERATIONNELLES SUR LA

CONCEPTION DES HELICOPTERES DE COMBAT]

Jean-Pierre Dubreuil /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 10 p In FRENCH

Avail: NTIS HC A12/MF A01

Three areas of helicopter design were examined: helicopter performance engineering; operational requirements for combat; and instrumentation. Helicopter performance is discussed in terms of controllability and flight speed. Operational characteristics include detectability, vulnerability, and survivability. The avionics are addressed in terms of man machine systems and display devices. T.M.

N81-33154# Costruzioni Aeronautiche Giovanni Agusta S.p.A., Varese (Italy).

DESIGN FOR MAXIMUM EFFECTIVENESS IN THE NAVY ROLE

Paolo Bellavita /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 20 p

Avail: NTIS HC A12/MF A01

The tremendous increase of the submarine threat in terms of speed, depth and weapon systems has forced the navies to review the concepts followed until today for the anti submarine warfare (ASW). Particularly for the peculiar Mediterranean environment new operational requirements for typical helicopter ASW missions must be developed taking also into account the future availability of low frequency, high range Sonar. To get the maximum profit from this technological improvement, missions should be planned with unusual long time in the search area both in terms of longer hovering and longer Time on Station many miles from the home ship in connection with high air temperature, wind absence, high rotor thrust margin and complete fly away capability in case of engine failure during sonar operation. The optimization of the helicopter design parameters to achieve the maximum effectiveness in the ASW role within the Italian Scenario and the engineering parametric techniques used are described. Author

N81-33155# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

THE IMPACT OF OPERATIONAL REQUIREMENTS ON THE COMPROMISE OF DESIRED FEATURES IN ROTORCRAFT DESIGN

Klaus F. M. Schymanietz /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 17 p refs

Avail: NTIS HC A12/MF A01

The increase of influence for helicopters in military missions can be related to more diversification as well as special designed types. General valid aspects include the all-weather capability, high performance and agility, low vulnerability and detectability and all together high mission effectiveness. The addressed systems can be divided in three areas, the design of the dynamic systems including the rotor- and propulsion-system, the structural design, and the design of the equipment systems. In the first area, the dynamic systems and components, the general, i.e., civil and military, trend is to be seen towards more economy, use of advanced materials, aerodynamic efficiency etc. In the military field in addition high agility, i.e., high maneuverability and high installed power, is required. Derived from the mission task high demands are set in the structural field, esp. the crashworthiness, i.e., high energy absorption by constructional means and specific materials. Dependent on operational requirements as all-weather capability, autonomous navigation, automatic hover the field of equipments of today's and future weapon systems becomes more and more important and complex. Author

N81-33156# National Academy of Sciences - National Research Council, Washington, D. C. Assembly of Engineering.

US MILITARY V/STOL: WHO NEEDS IT? WANTS IT? CAN AFFORD IT?

David C. Hazen /n AGARD The Impact of Mil. Appl. on Rotorcraft and V/STOL Aircraft Design Jun. 1981 7 p

Avail: NTIS HC A12/MF A01

For a period of thirty years, fixed wing V/STOL technology has been under development. Of all the concepts investigated, only the vectored thrust approach employed in the AV-8A Harrier has found application in the combat forces of the Western World.

This application was itself more the result of a technology push than of any clearly perceived operational pull. Once incorporated in operational units, however, the flexibility of basing displayed by the Harrier led to the evolution of entirely new operation concepts--and the requirement for improved aircraft to meet them. There are clear indications that the vulnerability of aircraft bases both ashore and afloat may make the V/STOL option essential in the future. Constrained by limited budgets and unimpressed by the performance currently available from V/STOL machines, the U.S. Services, other than the Marines, have no plans for introducing V/STOL into their forces, preferring instead to keep the technology on the shelf for future applications. If, however, V/STOL is to be effective in meeting future needs, the operational experience and doctrine to employ it must be developed now to guide the design of the machines that will be required. It is becoming increasingly critical that this Catch 22 be broken--and soon. Author

N81-33158*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

ANALYSIS OF THE PERFORMANCE OF THE DRIVE SYSTEM AND DIFFUSER OF THE LANGLEY UNITARY PLAN WIND TUNNEL

Robert L. Stallings and Lowell E. Hasel Oct. 1981 67 p refs (NASA-TM-83168; L-14543) Avail: NTIS HC A04/MF A01 CSCL 01A

A broad program was initiated at the Langley Research Center in 1973 to reduce the energy consumption of the laboratory. As a part of this program, the performance characteristics of the Unitary Plan Wind Tunnel were reexamined to determine if potential methods for increasing the operating efficiencies of the tunnel could be formulated. The results of that study are summarized. The performance characteristics of the drive system components and the variable-geometry diffuser system of the tunnel are documented and analyzed. Several potential methods for reducing the energy requirements of the facility are discussed. T.M.

N81-33159*# National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

STABILITY AND CONTROL CHARACTERISTICS OF A THREE-SURFACE ADVANCED FIGHTER CONFIGURATION AT ANGLES OF ATTACK UP TO 45 DEG

William P. Henderson and Laurence D. Leavitt Sep. 1981 47 p refs (NASA-TM-83171; L-14433) Avail: NTIS HC A03/MF A01 CSCL 01A

The tests were conducted at Mach numbers from 0.40 to 0.90, at angles of attack up to 45 deg for the lower Mach numbers, and at angles of sideslip up to 15 deg. The model variations under study included adding a canard surface and deflecting horizontal tails, ailerons, and rudders. T.M.

N81-33160*# Military Academy, West Point, N. Y.

EXPERIMENTAL AND THEORETICAL STUDY OF THREE INTERACTING, CLOSELY-SPACED, SHARP-EDGED 60 DEG DELTA-WINGS AT LOW SPEEDS Final Report

H. F. Faery, Jr., J. K. Strozier, and J. A. Ham Washington NASA Oct. 1981 47 p refs Sponsored by NASA (NASA-CR-3460) Avail: NTIS HC A03/MF A01 CSCL 01A

Wind tunnel tests were conducted to determine the subsonic longitudinal aerodynamic characteristics of lifting configuration consisting of a 60 deg delta main wing with two smaller 60 deg delta wings (called sub-wings) attached underneath. The test was designed to determine the effects on lift, drag, and pitching moment due to various placement of the subwings in relation to the main wing. Test results indicate the increasing vertical separation between the main wing and the sub-wings produced the most significant results: a 23.1% increase in maximum lift coefficient, a reduction in drag coefficient at high lift coefficients, and an increase in longitudinal stability. Lateral separation of the sub-wings produced no significant changes. Placement of the sub-wings rearward increases the initial lift curve slope and maximum lift coefficient and also increase the longitudinal stability. Results of a computer study using a vortex lattice code supported the experimental conclusions. M.G.

N81-33161# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

INVESTIGATION OF UNSTEADY AIRLOADS ON WINGS WITH OSCILLATING CONTROL FOR ACTIVE CONTROL

PURPOSES

W. Geissler (DFVLR, Goettingen, West Germany) Jul. 1981 16 p refs Presented at 52nd Meeting of the AGARD Structures and Mater. Panel, Cesme, Turkey, 5-10 Apr. 1981 (AGARD-R-699; ISBN-92-835-1392-2) Avail: NTIS HC A02/MF A01

Intensive experimental investigations were carried out on a wing section with oscillating control including a streamlined gap between both wing parts. Steady as well as unsteady pressure distributions were measured outside and inside the gap region for various incidences, flap angles, and frequencies. In addition to the experimental investigations, a calculation procedure was developed taking into account the real boundaries of the configuration including the gap region and assuming the fixed wing part and the oscillating control as two lifting systems with two Kutta conditions and correspondingly two wakes behind wing and control. Comparisons between theory and experiment are discussed in detail and the major influences and effects of viscosity are pointed out. The results lead to special conclusions for the applicability of lifting systems for active control purposes. J.M.S.

N81-33162*# General Dynamics Corp., Fort Worth, Tex. **EVALUATION OF PRESSURE AND THERMAL DATA FROM A WIND TUNNEL TEST OF A LARGE-SCALE, POWERED, STOL FIGHTER MODEL Final Report, 4 Jun. 1980 - 4 Jun. 1981**

G. A. Howell, E. L. Crosthwait, and M. C. Witte Jun. 1981 987 p refs (Contract NAS2-10649) (NASA-CR-166170) Avail: NTIS HC A99/MF A01 CSCL 01A

A STOL fighter model employing the vectored-engine-over wing concept was tested at low speeds in the NASA/Ames 40 by 80-foot wind tunnel. The model, approximately 0.75 scale of an operational fighter, was powered by two General Electric J-97 turbojet engines. Limited pressure and thermal instrumentation were provided to measure power effects (chordwise and spanwise blowing) and control-surface-deflection effects. An indepth study of the pressure and temperature data revealed many flow field features - the foremost being wing and canard leading-edge vortices. These vortices delineated regions of attached and separated flow, and their movements were often keys to an understanding of flow field changes caused by power and control-surface variations. Chordwise blowing increased wing lift and caused a modest aft shift in the center of pressure. The induced effects of chordwise blowing extended forward to the canard and significantly increased the canard lift when the surface was stalled. Spanwise blowing effectively enhanced the wing leading-edge vortex, thereby increasing lift and causing a forward shift in the center of pressure. Author

N81-33163# ARO, Inc., Arnold Air Force Station, Tenn. **WIND TUNNEL TESTING OF A WINDSHIELD MATERIAL OR SUPERSONIC AIRCRAFT Final Report**

D. W. Stallings (Calspan Field Services, Inc.) and A. S. Hartman (Calspan Field Services, Inc.) AEDC May 1981 45 p refs Sponsored by AF (AD-A103383; AEDC-TSR-81-V18) Avail: NTIS HC A03/MF A01 CSCL 01/3

Wind tunnel tests of windshield material intended for use on supersonic aircraft were conducted in the von Karman Facility Hypersonic Wind Tunnel B at a free-stream Mach number of 6 and tunnel stilling chamber conditions of 146 psia and 495 F. The wedge technique was used to provide a local Mach number of 2.5 over the windshield specimen. Selected results are presented to illustrate the test techniques and typical data obtained. Author (GRA)

N81-33173# Directorate of Nuclear Safety, Kirtland AFB, N.Mex. Air Force Inspection and Safety Center.

SAFETY STUDY: PRIME NUCLEAR AIRLIFT FORCE (PNAF) MISSIONS INVOLVING THE USE OF C-130 AND C-141 AIRCRAFT Final Report

John G. Dean Jan. 1981 35 p refs (AD-A103282; AFISC-TR-81-001) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report estimates the accident rate for C-130 and C-141 aircraft while involved in the air transportation of nuclear weapons as cargo. Causes and factors involved in accidents are shown, and beneficial practices are identified. Author (GRA)

N81-33174# Civil Aeromedical Inst., Oklahoma City, Okla.
IMPROVING THE CRASHWORTHINESS OF GENERAL AVIATION AIRCRAFT BY CRASH INJURY INVESTIGATIONS

William R. Kirkham May 1981 17 p refs Sponsored by FAA
 (AD-A103316; FAA-AM-81-10) Avail: NTIS
 HC A02/MF A01 CSCL 01/2

An accident investigative research program has correlated injuries to aircraft occupants with the accident severity and structural changes in the crash. Findings brought to the attention of aircraft manufacturers have led to specific aircraft being made more crashworthy. Following the finding of a failure in a shoulder harness attachment the manufacturer strengthened the attachment brace. The way a shoulder harness was joined to a lapbelt was modified as a followup to failure of the attachment in an accident. Noted fractures of lapbelt and shoulder harness cable tie-downs led to the use of stronger cables and modification of the installation. Other accident findings resulted in a shoulder strap guide being placed on an inertia reel and a side-mounted seat being modified. GRA

N81-33175# Federal Aviation Administration, Washington, D.C.
 Office of Aviation Medicine.

EMERGENCY CABIN LIGHTING INSTALLATIONS: AN ANALYSIS OF CEILING- VERSUS LOWER CABIN-MOUNTED LIGHTING DURING EVACUATION TRIALS

Burton P. Chesterfield, Paul G. Rasmussen, and Robert D. Dillon Feb. 1981 46 p refs
 (AD-A103191; FAA-AM-81-7) Avail: NTIS HC A03/MF A01 CSCL 01/2

Six series of human subject evacuation tests were conducted to compare the evacuation rates with two different emergency lighting systems in an aircraft cabin filled with nontoxic white smoke. Cabin emergency lighting and exit signs mounted near the ceiling were almost completely obscured by smoke, which layered most heavily in the upper one-half of the cabin. A comparison lighting system mounted below layered smoke in aisle seat armrests, with exit signs mounted at and below the cabin midpoint, provided light directly in the aisle and cross aisle. Results indicated that lights and signs mounted lower in the cabin were more readily visible in smoke and enabled subjects to evacuate from a smoke-filled cabin more rapidly than conventional ceiling-mounted lights and signs. Author (GRA)

N81-33177# Naval Air Development Center, Warminster, Pa.
 Aircraft and Crew Systems Technology Directorate.
TEST AND EVALUATION OF AN EXPERIMENTAL FEASIBILITY PROTOTYPE PASSIVE SEAT MOUNTED LIMB RESTRAINT SYSTEM

Marcus Schwartz 20 May 1981 63 p
 (AD-A104161; NADC-81065-60) Avail: NTIS
 HC A04/MF A01 CSCL 13/6

An experimental feasibility prototype of passive seat mounted limb restraint system was tested under various conditions both statically and dynamically on the NAVAIRDEVCEEN Ejection Tower and the Dayton T. Brown windblast facility. The Ejection Tower tests resulted in successful and repeatable entrapment of the arm and legs, and good tensioning of the restraint lines through one-way snubbers. The windblast test series also resulted in successful entrapment of the limbs at various pitch and yaw angles up to 600 knots. The results of this T&E study clearly showed the feasibility of the system to provide the necessary protection to the crewmember during the simulated operation environments, and also to meet the passive requirements which result in no additional encumbrances on the crewmember. Author (GRA)

N81-33181# Federal Aviation Administration, Atlantic City, N.J.
 Technical Center.

MULTISITE TESTING OF THE DISCRETE ADDRESS BEACON SYSTEM (DABS) Interim Report, Mar. - Sep. 1980

J. L. McMillen, J. W. Davis, and R. J. Spadea, Jr. Jul. 1981 61 p refs
 (FAA Proj. 034-241-510)
 (AD-A103575; FAA-CT-81-9; FAA-RD-81-49) Avail: NTIS
 HC A04/MF A01 CSCL 17/7

This report contains results of tests performed in an environment of multiple Discrete Address Beacon System (DABS)

sensors, one each located at Clementon and Elwood, New Jersey, and the Federal Aviation Administration (FAA) Technical Center, Atlantic City Airport, New Jersey. These DABS sensors were tested in various degrees of intersensor communication that ranged from a full network of connected sensors to a fully nonnetted configuration. The multiple DABS sensors were tested in four major areas: network management, surveillance processing, data link processing, and intersensor communications. It is concluded that the performance of the DABS sensors in multisite configurations meets or exceeds the requirements specified in the DABS engineering requirement (FAA-ER-240-26). Author (GRA)

N81-33182# Federal Aviation Administration, Atlantic City, N.J.
CROSSTALK LEVELS OF SPEECH PLUS DATA IN REMOTE COMMUNICATION AIR-GROUND (RCAG) Final Report, Aug. 1979 - May 1980

Albert J. Rehmann Jun. 1981 61 p refs
 (AD-A103351; FAA-CT-80-38) Avail: NTIS
 HC A04/MF A01 CSCL 17/2

The Federal Aviation Administration (FAA) is proposing the addition of a digital data channel to the existing telephone lines which connect air route traffic control centers (ARTCC's) with Remote Communication Air-Ground (RCAG) sites to economically transfer remote monitoring system (RMS) parameters and control data between the ARTCC's and the sites. FAA Specification FAA-E-2699a establishes the maximum allowable interference level to pilot/controller communications which would be allowed to result from the addition of the data channel. The tests described in this document were designed to verify that the requirements in FAA-E-2699a are sufficient to prevent disturbance to normal air traffic control (ATC) operations. The tests were performed by simulating and existing communications channel using data modems and samples of present-day Voice Frequency Control System (VFCS) equipment. Crosstalk levels of speech and data were measured under actual operating conditions. The test results indicated that the addition of an RMS data channel to existing FAA telephone lines is technically feasible and that the requirement in FAA-E-2699a concerning the data crosstalk in the audio portion of the communication channel is not adequate to prevent disturbance to normal ATC operations. The requirements concerning data crosstalk in the control portion and VFCS crosstalk in the data portion of the channel are sufficient. Author (GRA)

N81-33183# Federal Aviation Administration, Atlantic City, N.J.
EN ROUTE DISCRETE ADDRESS BEACON SYSTEM/AIR TRAFFIC CONTROL (BUILD 1) TECHNICAL TESTING

Robert E. Copes, III and Richard V. Dardano Jul. 1981 35 p
 (FAA Proj. 122-115-540)
 (AD-A103894; FAA-CT-80-30; FAA-RD-81-31) Avail: NTIS
 HC A03/MF A01 CSCL 17/7

Tests of the Discrete Address Beacon System (DABS) in an air traffic control (ATC) en route National Airspace System (NAS) environment were conducted at the Federal Aviation Administration (FAA) Technical Center. These tests included: (1) surveillance performance in the areas of track initiation, track continuity, and track swap; and (2) surveillance related communication responses employing the Common International Civil Aviation Organization (ICAO) Data Interchange Network (CIDIN) protocol for Air Traffic Control Radar Beacon System (ATCRBS) identification (ID) requests. Test results indicate that the en route DABS/ATC Build I software successfully processed DABS sensor surveillance information. Although analyzed on a limited basis, the transmission of surveillance related communication messages between the DABS sensor and the en route DABS/ATC Build I system is considered to operate as expected. It is concluded that the DABS/ATC en route Build I system accepts, processes, tracks, and displays DABS and ATCRBS surveillance data from one DABS and multiple ATCRBS sensors with no degradation to the baseline function of the NAS software system A3d2.4. Author (GRA)

N81-33184# Federal Aviation Administration, Washington, D.C.
 Air Traffic Service.

OPERATION FREE FLIGHT: AN OPERATIONAL EVALUATION OF DIRECT ROUTE FLIGHT PLAN FILING IN TODAY'S NATIONAL AEROSPACE SYSTEM Final Report

Wayne Minnick Jul. 1981 87 p
 (AD-A104150; FAA-AT-81-1) Avail: NTIS HC A05/MF A01 CSCL 17/7

This report presents the results of an operational evaluation

concerning the feasibility of permitting the filing of direct route flight plans, without route definition, between departure and arrival area fixes serving selected city-pairs. The evaluation was conducted with the voluntary participation of Eastern, United, and Pan American Airlines during the period June 1 through December 31, 1980. Objectives of Operation Free Flight were to obtain factual information about air traffic control (ATC) handling of test aircraft on direct routings, system prohibitions to the concept, general pilot attitude regarding the utility of their RNAV equipment, potential fuel savings, and ATC system impact. The evaluation was conducted throughout the contiguous United States between 27 city-pairs. The primary conclusions were: the operational concept of filing direct, great circle routes between departure and arrival area fixes, at altitudes above Flight Level 290, in a radar environment; incompatibility with traffic arrival flow at destination airports was determined to be the most significant system prohibition; pilot attitude was skewed in a positive direction; potential fuel savings are projected to be in excess of 40,000,000 gallons per year, and, there was no adverse impact to the ATC system. Author (GRA)

N81-33188# Transportation Research Board, Washington, D.C.
COMPUTER GRAPHICS APPLICATIONS
 Michael R. Couture, Jerome M. Lutin, Dale Livingston, Edward J. Kobialka, and Neil W. Polhemus 1980 42 p refs
 (PB81-215246; TRB/TRR-787; ISBN-0-309-03201-6;
 LC-81-9570; ISSN-0361-1981) Avail: NTIS
 HC A03/MF A01 CSCL 17G

Issues in computer graphics application are reported. The following areas are discussed: (1) computer graphics for transit planning, an empirical study, (2) interactive graphics model for testing stochastic traffic assignment algorithms, (3) use of computer graphics to analyze navigational performance and jet route separation, (4) applications of interactive graphics in Michigan's statewide transportation modeling system. GRA

N81-33190* Beech Aircraft Corp., Wichita, Kans.
APPLICATION OF ADVANCED TECHNOLOGIES TO DERIVATIVES OF CURRENT SMALL TRANSPORT AIRCRAFT Final Report
 P. P. Renze and J. E. Terry Jul. 1981 112 p refs
 (Contract NAS2-10571)
 (NASA-CR-166197) Avail: NTIS HC A06/MF A01 CSCL 01C

Mission requirements of the derivative design were the same as the baseline to readily identify the advanced technology benefits achieved. Advanced technologies investigated were in the areas of propulsion, structures and aerodynamics and a direct operating cost benefit analysis conducted to identify the most promising. Engine improvements appear most promising and combined with propeller, airfoil, surface coating and composite advanced technologies give a 21-25 percent DOC savings. A 17 percent higher acquisition cost is offset by a 34 percent savings in fuel used. T.M.

N81-33191* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

STATISTICS OF SOME ATMOSPHERIC TURBULENCE RECORDS RELEVANT TO AIRCRAFT RESPONSE CALCULATIONS

William D. Mark and Raymond W. Fischer Washington NASA Sep. 1981 238 p refs
 (Contract NAS1-14837)
 (NASA-CR-3464) Avail: NTIS HC A11/MF A01 CSCL 01C

Methods for characterizing atmospheric turbulence are described. The methods illustrated include maximum likelihood estimation of the integral scale and intensity of records obeying the von Karman transverse power spectral form, constrained least-squares estimation of the parameters of a parametric representation of autocorrelation functions, estimation of the power spectra density of the instantaneous variance of a record with temporally fluctuating variance, and estimation of the probability density functions of various turbulence components. Descriptions of the computer programs used in the computations are given, and a full listing of these programs is included. T.M.

N81-33192# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.

ANALYSIS AND DESIGN OF SUPERSONIC AIRCRAFT BASED ON INVISCID NONLINEAR EULERIAN EQUATIONS. PART 1: ROTATIONAL EULER SOLUTIONS WITH EXPLICIT

SHOCK FITTING Final Report, 1 Oct. 1977 - 1 Apr. 1979

M. J. Siclari and F. Marconi Oct. 1980 118 p refs
 (Contract F33615-77-C-3126; AF Proj. 2404)
 (AD-A103434; RE-623-Pt-1; AFWAL-TR-80-3110-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 01/3

A computer program has been developed to compute the inviscid supersonic flow over delta wings and smooth wing-body configurations. A second-order accurate predictor-corrector finite-difference scheme is used to integrate the three dimensional Euler equations in regions of continuous flow. Bow shock and crossflow-induced embedded shocks are explicitly computed as discontinuities which simultaneously satisfy the characteristic and the Rankine-Hugoniot conditions. In computing the flow about complex wing cross sections, the use of appropriate conformal mappings was an important factor in developing a computational mesh capable of resolving the large flow gradients that are inevitable in the vicinity of wing leading edges. Geometry programs were developed to supply the appropriate geometric boundary conditions necessary to compute complex wing cross sections. New starting solutions were developed that were more appropriate to thin-wing cross sections. In the initial stage of development, the flow about conical wings was computed for a two-fold purpose. Conical Euler solutions would be used as starting conditions for conical wing-bodies and three dimensional wings and the conical problem would uncover potential problem areas in the computation of these flows without the added complexity of geometrical variations. The conical problem led to the development of special techniques to resolve the vortical layer that inevitably develops on the body surface. Typical results are shown for subsonic and supersonic leading edge delta wings and wing-body combinations. GRA

N81-33194# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

DESIGN OF A SLOT HEIGHT DISTRIBUTION FOR INCREASED HOVER CONTROL POWER ON A CIRCULATION CONTROL ROTOR Final Report

Daniel W. Poe Dec. 1980 31 p refs
 (AD-A103535; DTNSRDC/ASED-80/24) Avail: NTIS
 HC A03/MF A01 CSCL 01/3

The Circulation Control Rotor Performance Prediction computer program was used with the XH-2/CCR rotor configuration to determine a slot height distribution that would improve control power in hover without causing excessive cyclic pressure requirements for trim in forward flight. Effects of total slot area as well as distribution were considered. The final distribution was constrained by a minimum practical slot height setting of 0.002 in. and a minimum unpressurized blade slot area of 3.0 square inches. Several distributions were evaluated. Noteworthy trends that emerged are: (1) A negatively tapered slot height distribution is favorable to producing hub moments in hover, and (2) a uniform distribution (zero taper) requires the lowest cyclic pressure for trim at 120 knots. The final distribution selection exhibited a 38-percent improvement in predicted hub moment over a slot height distribution previously used on the flight demonstrator. Author (GRA)

N81-33195# Tennessee Univ. Space Inst., Tullahoma.
A FLIGHT TEST EVALUATION OF THE BALL-BARTOE JETWING PROPULSIVE LIFT CONCEPT Progress Report, 18 Apr. 1980 - 17 Apr. 1981

Ralph D. Kimber 1 Jul. 1981 191 p refs
 (Contract N00019-80-C-0126)
 (AD-A103579; UTSI-81-1) Avail: NTIS HC A09/MF A01 CSCL 01/3

The need for military aircraft that will operate from short unimproved airfields, and the decks of smaller aircraft carriers has increased in recent years due to a changing world situation and the shrinking of the dollar. Such aircraft need to be fuel efficient, quiet, maneuverable, have low infrared signature, and carry a large useful load. The Ball-Bartoe 'Jetwing' is a single engine upper surface blowing concept which offers the possibility of achieving these objectives. The 'Jetwing' concept achieves supercirculation lift and STOL performance by ducting all engine air through the leading edge of the wing and ejecting it over the top surface of the wing through a slot nozzle. This nozzle extends along approximately 70% of the wing span. A Coanda flap is mounted at the trailing edge of the blown portion of the wing. In addition to the main wing, a smaller wing panel is mounted above the slot nozzle. The air passage between the main wing and the smaller upper wing acts as an ejector to reduce installed thrust losses. For high speed applications that

concept may be used without this upper wing. A thrust reversing method is also incorporated into the concept. The thrust is reversed by rotating the top of the slot nozzle so as to close the nozzle and open a reverse flow path. This report covers the flight test program of the Jetwing research airplane. GRA

N81-33196# Dayton Univ., Ohio. Research Inst.
ALTERNATE T-38 TRANSPARENCY DEVELOPMENT. PART 1: INITIAL ANALYSIS AND DESIGN Final Report, Jan. 1979 - Sep. 1980

Blaine S. West and Kenneth I. Clayton Wright-Patterson AFB, Ohio AFWAL Nov. 1980 58 p refs 2 Vol.
(Contracts F33615-76-C-3103; F33615-80-C-3401; AF Proj. 2202: AF Proj. 1926)
(AD-A103261; UDR-TR-80-91-Pt-1; AFWAL-TR-80-3132-Pt-1)
Avail: NTIS HC A04/MF A01 CSDL 01/3

T-38 missions at speeds above the existing crew enclosure damage threshold will result in flight safety risk to aircraft and crew. This report documents the design development of alternate T-38 transparencies having the capability of defeating the impact of a four pound bird at aircraft speeds up to 400 knots. To accomplish the desired windshield/canopy redesign, a feasibility study was conducted, damage probability was determined, the birdstrike capability of existing transparencies was experimentally evaluated, edge attachment screening specimens were laboratory tested, and finite element analyses were made. Major findings from each task have been integrated into the detail design of a birdstrike resistant forward windshield panel, recommended for full-scale hardware fabrication, testing, and evaluation. Forward canopy and instructor windshield concepts are also discussed.

Author (GRA)

N81-33197# Dayton Univ., Ohio. Research Inst.
ALTERNATE T-38 TRANSPARENCY DEVELOPMENT. PART 2: BASELINE BIRDSTRIKE TESTING Final Report, Jun. 1979 - Oct. 1980

Blaine S. West Wright-Patterson AFB, Ohio AFWAL Dec. 1980 92 p 2 Vol.
(Contracts F33615-76-C-3103; F33615-80-C-3401; AF Proj. 2202: AF Proj. 1962)
(AD-A103262; UDR-TR-80-61-Pt-2; AFWAL-TR-80-3132-Pt-2)
Avail: NTIS HC A05/MF A01 CSDL 01/3

T-38 missions at speeds above the existing crew enclosure damage threshold will result in flight safety risk to aircraft. This report documents the results of a full-scale flight hardware test program to establish the bird impact resistance of existing T-38 forward transparencies. The failure threshold for the forward windshield and forward canopy for a four-pound birdstrike at six impact locations was established. Test results are reported and discussed in detail.

Author (GRA)

N81-33199# Calspan Corp., Buffalo, N. Y.
AN EXPERIMENTAL INVESTIGATION OF VTOL FLYING QUALITIES REQUIREMENTS OR SHIPBOARD LANDINGS Final Report, Apr. 1978 - Sep. 1980

Robert C. Radford, Dominick Andrisani, II, and John L. Beilman Aug. 1981 262 p refs
(Contract N62269-78-C-0043)
(AD-A104137; CALSPAN-6286-F-1; NADC-77318-60) Avail: NTIS HC A12/MF A01 CSDL 01/2

This fifth simulation experiment, using the U.S. Navy X-22A variable stability V/STOL aircraft, was undertaken to generate data for the development to flying qualities and advanced flight control system design criteria for the visual shipboard landing task. Since a broad range of flying qualities was simulated, actual landings were not performed because of flight safety considerations. Instead, a discrete three dimensional position tracking task, presented to the pilot on a Head-Up-Display (HUD), was devised to evoke pilot control and stabilization activity similar to that in the actual shipboard environment. A microwave landing system with precision ranging capability served as the guidance sensor for both the translational rate flight control system mechanizations and for the HUD tracking information. A total of 3 evaluations were performed of various horizontal and vertical translational rate flight control system dynamics. The primary results of the program defined regions of satisfactory and acceptable flying qualities as functions of velocity command gain and the time constant of velocity response. The limits on command gain and time constant for satisfactory flying qualities indicated by this experiment are considerably smaller than those determined in ground simulator experiments.

Author (GRA)

N81-33200# Sandia Labs., Albuquerque, N. Mex. Div. 1556.
ADVANCED COMPOSITE AIRCRAFT ELECTROMAGNETIC DESIGN AND SYNTHESIS

R. F. Wallenberg (Syracuse Research Corp., N.Y.), J. A. Birken (Naval Air System Command, Washington, D.C.), and O. Milton Apr. 1981 9 p refs Presented at the IEEE Intern. Symp. on Electromagnetic Compatibility Record, Boulder, Colo., 18-20 Aug. 1981

(Contract DE-AC04-76DP-00789)

(SAND-81-1278C; CONF-810816-1; SRC-TR-81-1170) Avail: NTIS HC A02/MF A01

The ramifications of using advanced composite materials in more upcoming aircraft were investigated. Mission requirements include fly by wire systems surviving increased threats when contained in a composite material fuselage which generally provides poor electromagnetic shielding. The coupling of lightning and a nuclear electromagnetic pulse to aircraft comprised of composite materials are addressed. DOE

N81-33201# Peat, Marwick, Mitchell and Co., San Francisco, Calif.

RESPONSES TO COMMENTS OF AIR TRANSPORT ASSOCIATION OF AMERICA ON AIRCRAFT TOWING FEASIBILITY STUDY

Jun. 1981 112 p refs

(Contract DE-AC01-79CS-50069)

(DE81-029834; DOE/CS-50069/T1)

Avail: NTIS

HC A06/MF A01

A preliminary assessment of the constraints on and feasibility of extended aircraft towing between airport runways and terminal gate areas with engines shutdown is made. Past aircraft towing experience and the state of the art in towing equipment are reviewed. Safety and operational concerns associated with aircraft towing are identified, and the benefits and costs of implementing aircraft towing at 20 major US airports are analyzed. It was concluded that extended aircraft towing is technically feasible and that substantial reductions in aircraft fuel consumption and air pollutant emissions can be achieved through its implementation. It was also concluded that, although capital and operating costs associated with towing would be increased, net savings could generally be attained at these airports. Because of the lack of past experience and the necessity of proving the cost effectiveness of towing concept, a demonstration of the feasibility of large scale aircraft towing is necessary. DOE

N81-33203*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SIMULATOR EVALUATION OF SEPARATION OF DISPLAY PARAMETERS IN PATH-FOLLOWING TASKS

Garimella R. Sarma and James J. Adams Oct. 1981 44 p refs

(NASA-TP-1915; L-14590) Avail: NTIS HC A03/MF A01 CSDL 01D

A five degree of freedom, fixed base simulation changing the location of the displays for bank angle, pitch angle, heading angle, and the vertical and lateral displacement from an instrument landing system path was studied. It is shown that the accuracy of the lateral path following and the pilot aircraft system dynamic characteristics deteriorate when bank angle is displayed separated from the other attitudes. It is found that best results are obtained when bank, heading, and pitch angles are displayed together and vertical and lateral displacements are displayed at another location in the display. E.A.K.

N81-33204# Aircraft Research and Development Unit, Edinburg (Australia).

DEVELOPMENT OF AN INSTRUMENT FOR THE ACCURATE MEASUREMENT OF AIRCRAFT AIRSPEED AND ALTITUDE

G. G. Readett Jul. 1981 28 p refs

(AD-A103421; ARDU-TI-466) Avail: NTIS HC A03/MF A01 CSDL 01/4

Aircraft Research and Development Unit has developed a trailing pitot-static probe suitable for determining pressure error corrections for aircraft airspeed and altitude systems. The instrument is suitable for use with helicopters where both pitot and static pressure measurements on the aircraft could be subject to pressure errors due to rotor downwash. The probe is accurate to better than 1% and was tested and shown to be satisfactory over a speed range of 40 to 120 knots. Author (GRA)

N81-33205# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

DEVELOPMENT OF AN ANALYTICAL TECHNIQUE FOR THE OPTIMIZATION OF JET ENGINE AND DUCT ACOUSTIC LINERS Semiannual Status Report, 3 Jan. - 31 Aug. 1981 Ben T. Zinn and William L. Meyer 1981 30 p refs (Grant NAG1-133)

(NASA-CR-164872) Avail: NTIS HC A03/MF A01 CSDL 21E

A special integral representation of the external solutions of the Helmholtz equation is described. The analytical technique developed for the generation of the optimum acoustic admittance for an arbitrary axisymmetric body is also presented along with some numerical procedures and some preliminary results for a straight duct. A.R.H.

N81-33206# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SIMPLIFIED OFF-DESIGN PERFORMANCE MODEL OF A DAY TURBOFAN ENGINE CYCLE

Frederick J. Lallman Sep. 1981 33 p refs

(NASA-TM-83204) Avail: NTIS HC A03/MF A01 CSDL 21E

The specific thrust and fuel-air ratio for a dry turbofan engine cycle were calculated for several power levels over a range of altitudes and Mach numbers. The engine has a design fan pressure ratio of 2.9, compressor pressure ratio of 8.0, and bypass ratio of 0.6. Nominal engine component curves were picked to approximate the calculated data to construct a simplified model of the off-design performance of the engine. The model was then used to construct a simplified design-point engine model for the full-power condition. Author

N81-33210# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

PROPULSIVE LATERAL CONTROL NOZZLE Patent Application

Paul L. Coe, Jr. and Albert B. Graham, inventors (to NASA) (Old Dominion Univ.) Filed 18 Nov. 1980 9 p

(NASA-Case-LAR-12136-1; US-Patent-Appl-SN-208093) Avail: NTIS HC A02/MF A01 CSDL 01C

The invention relates to a trailing edge flap system useful in increasing low speed lift and low speed roll control in supersonic aircraft. Two trailing edge flaps (upper and lower) extend from the aircraft's engine exhaust nozzle. In the high lift mode of operation, a diverter block pushes the upper flap away from the nozzle, thereby exposing a flow passageway. Exhaust flow through the passageway tends to decrease boundary layer separation. To provide propulsive lateral control, the diverter block of one wing may be selectively closed, thereby reducing the lift on that wing. NASA

N81-33211# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SIMULATOR EVALUATION OF THE EFFECTS OF REDUCED SPOILER AND THRUST AUTHORITY ON A DECOUPLED LONGITUDINAL CONTROL SYSTEM DURING LANDINGS IN WIND SHEAR

G. Kimball Miller, Jr. Oct. 1981 51 p refs

(NASA-TM-83188; L-14652) Avail: NTIS HC A04/MF A01 CSDL 01C

The effect of reduced control authority, both in symmetric spoiler travel and thrust level, on the effectiveness of a decoupled longitudinal control system was examined during the approach and landing of the NASA terminal configured vehicle (TCV) aft flight deck simulator in the presence of wind shear. The evaluation was conducted in a fixed-base simulator that represented the TCV aft cockpit. There were no statistically significant effects of reduced spoiler and thrust authority on pilot performance during approach and landing. Increased wind severity degraded approach and landing performance by an amount that was often significant. However, every attempted landing was completed safely regardless of the wind severity. There were statistically significant differences in performance between subjects, but the differences were generally restricted to the control wheel and control-column activity during the approach. M.G.

N81-33214# Army Cold Regions Research and Engineering Lab., Hanover, N. H. Geotechnical Research Branch.

FABRIC INSTALLATION TO MINIMIZE REFLECTION

CRACK ON TAXIWAYS AT THULE AIRBASE, GREENLAND

Robert A. Eaton and Randy Godfrey May 1981 35 p refs (DA Proj. 4K0-78012-AAM-1)

(AD-A103737; CRREL-SR-81-10) Avail: NTIS HC A03/MF A01 CSDL 13/2

In August 1978 two types of fabrics were placed on sections of taxiways 1 and 3 of Thule AB, Greenland, to study the ability of fabrics with an AC 2.5 overlay to minimize reflection cracking in severe climates. Both fabrics should retain durability and mechanical strength under Thule's arctic conditions.

Author (GRA)

N81-33216# Mitre Corp., McLean, Va.

UPGRADED FAA AIRFIELD CAPACITY MODEL. VOLUME 1: SUPPLEMENTAL USER'S GUIDE

William J. Swedish Washington FAA Feb. 1981 119 p refs

(Contract DT-FA01-81-C-10001)

(AD-A104154; MTR-81W16-Vol-1; FAA-EM-81-1-Vol-1) Avail: NTIS HC A06/MF A01 CSDL 01/2

Input and output formats for easier usage and for the capability to compute runway capacity for up to eleven different percentages of arrivals in a single run (as opposed to a separate run for each percentage) are presented. Provisions for calculating the capacity of alternating arrivals to a pair of parallel runways are highlighted. Several other runway configurations were added to the model. Other changes made to the internal logic of the model which results in reduced running times and/or improved accuracy. The resulting capacities may, therefore, differ from the results obtained with the previous version. In most cases this will not affect the ranking of the potential airfield changes under evaluation. T.M.

N81-33217# Mitre Corp., McLean, Va.

UPGRADED FAA AIRFIELD CAPACITY MODEL. VOLUME 2: TECHNICAL DESCRIPTION OF REVISIONS

William J. Swedish Washington FAA Feb. 1981 161 p refs

(Contract DT-FA01-81-C-10001)

(AD-A104155; MTR-81W16-Vol-2; FAA-EM-81-1-Vol-2) Avail: NTIS HC A08/MF A01 CSDL 01/2

The FAA Airfield Capacity Model, a computer program designed to quickly calculate the runway capacity of an airport, has recently been upgraded. Several new features have been implemented in the upgraded version. Among these are improved input and output formats for easier usage, the capability to compute runway capacity for up to eleven different percentages of arrivals in a single run (as opposed to a separate run for each percentage), and provisions for calculating the capacity of alternating arrivals to a pair of parallel runways. Several other runway configurations have been added to the model, or improved, as well. Other changes have been made to the internal logic of the model which will result in reduced running times and/or improved accuracy. The resulting capacities may, therefore, differ from the results obtained with the previous version. In most cases this will not affect the ranking of the potential airfield changes under evaluation. This report documents the upgraded FAA Airfield Capacity Model. Volume 2 is a detailed technical description of the revisions to the program, including flow charts of the logic and evaluations of various alternative logics. This volume is intended as a programmer's guide, but it may also be useful for the experienced analyst who desires a fuller understanding of the model. GRA

N81-33238# National Aerospace Lab., Tokyo (Japan). First Airframe Div.

ANTI-SYMMETRIC ELASTIC PROPERTIES OF COMPOSITE PLATES OF SATIN WEAVE CLOTH

Takashi Ishikawa Jan. 1981 18 p refs

(NAL-TR-649T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Composite plates made of satin weave fabric show macroscopic antisymmetry and coupling effects. The essential mechanism of such behavior is basically clarified. Closed form solutions of the upper and lower bounds of the stiffness and compliance are obtained by the simplest series model in connection with the uniform stress and strain assumptions. Finite element analyses using 3-D isoparametric elements are also conducted. The solutions fall between both bounds within a certain restriction. The deviation of the actual quasimicromechanical conditions from

the simple assumptions can be observed through the FEM results. Rough estimation of thermal warping coefficients is carried out for carbon/epoxy and glass/polyimide 8th harness satin composites by simple measurements. More accurate results are provided by experiments for measuring thermal deflection under a small temperature change. These results confirm the theoretical predictions by both methods. Several comments on ways of preventing such phenomena are made based on the geometry of the fabric structures. Author

N81-33240# SRI International Corp., Menlo Park, Calif.
ENGINEERING EFFECTS OF ADVANCED COMPOSITE MATERIALS ON AVIONICS Final Technical Report, Sep. 1980 - Jun. 1981

W. Graf, J. Hamm, J. E. Navevicz, and D. E. Tremain Jul. 1981 132 p refs
 (Contract DAAK80-80-C-0806)
 (AD-A104015; USAAVRADCOM-80-0806-F) Avail: NTIS HC A07/MF A01 CSCL 11/4

This report discusses the effects of advanced composite materials on avionics equipment. Over 80 reports and articles on this subject have been collected; the bibliographic data resides in an on-line computer data base. A summary of previous and ongoing work is included. The impact of composite materials on avionics systems and subsystems is discussed, and the major problem areas identified (viz., lightning, EMP protection, antenna performance, EMI/EMC, and radar cross section reduction). Possible solutions and approaches to these problems are presented and the importance of tradeoff studies at the system level is stressed. Problems peculiar to helicopters are reviewed separately. The relation of this contract to the Advanced Composite Airframe Program (ACAP) is also discussed. Appendices present technical background on interference control and E3 hardening concepts. An extensive bibliography is included. Author (GRA)

N81-33241# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF ADVANCED INTERCEPTOR SUB-STRUCTURAL MATERIAL Final Report, 6 Sep. 1979 - 30 Sep. 1980

Norman R. Adsit and Julius Hertz Jul. 1981 129 p refs
 (Contract DAAG46-79-C-0081; DA Proj. 1W1-62113-A-661)
 (AD-A103836; AMMRC-TR-81-32) Avail: NTIS HC A07/MF A01 CSCL 11/4

The work reported herein is aimed at the development of ultra-high-modulus graphite/epoxy structures for use in future advanced*terminal interceptors (ATI). The work has shown that gore section layup used to fabricate interceptor frusta do not effect the strength or modulus of the frusta. Tests on flat panels representation of full thickness joints substantiated that the end joints will carry ATI loads. Finally, two short but full thickness frusta with antenna window cutouts were fabricated and tested. These frusta met the design goals. Analysis work has been completed and the design and materials are ready for a full-scale demonstration. To accomplish this, the preliminary design was reviewed and has been updated. A full-scale tool was designed and has been procured. Finally, a manufacturing process plan for the full-scale frustum was prepared. GRA

N81-33390# Ball Aerospace Systems Div., Boulder, Colo.
ADVANCED MICROSTRIP ANTENNA DEVELOPMENT. VOLUME 1: TECHNOLOGY STUDIES FOR AIRCRAFT PHASED ARRAYS Final Report, Apr. 1979 - Jun. 1980

Gary G. Sanford Jun. 1981 75 p refs
 (Grant DOT-TSC-1397)
 (AD-A103837; FAA-EM-80-11-Vol-1; TSC-FAA-80-15-Vol-1)
 Avail: NTIS HC A04/MF A01 CSCL 09/1

Work has continued on improvement of microstrip phased-array antenna technology since the first microstrip phased-array was flight-tested during the FAA 1974-1975 ATS-6 test program. The present development has extended this earlier work in three areas: the microstrip radiating elements, the array configuration, and the control circuitry. The effort has been successful in developing important new phased-array techniques. These techniques were demonstrated with working hardware, but a complete array was not within the scope of the program. Radiating elements with broad beamwidths were required to permit steering the array to angles near endfire. The most significant improvement was the development of a microstrip crossed-slot element. Dual-band or broad-band elements were developed to permit operation in both the receive and transmit

bands. Several approaches were experimented with, the most promising of which was the use of stacked crossed-slot elements. This achieves broad beamwidth and dual-band operation in a compact device. Static arrays for end-fire operation were investigated, and a 4x4 array demonstrated promise for this application. Several phase shifters were developed; the three-bit switched-line phase shifters gave excellent performance. GRA

N81-33392# Network Analysis Corp., Vienna, Va.
COMPUTER B (NAS-NAS) COMMUNICATIONS SUPPORT Final Report

Jul. 1981 171 p refs
 (Contract DOT-FA79WA-4335)
 (AD-A104145; NAC/FR-303F/01; FAA-RD-81-68) Avail: NTIS HC A08/MF A01 CSCL 17/2

An analysis has been performed to determine the feasibility and desirability of incorporating into NADIN the message traffic currently serviced by the Computer B (NAS-NAS) Network. The use of NADIN to support NAS-NAS communications was found to be feasible and cost-effective. The most attractive approach to such support was found to be the enhancement of the NADIN architecture, using packet-switching technology, to provide virtual circuit and alternate routing capabilities between all NADIN backbone modes. The results of this analysis are to serve as inputs to other tasks under this contract that will investigate a consolidated NADIN enhancement approach for supporting future FAA data communications requirements, including enhancements to support the replacement of FAA's enroute computer system, and the Remote Maintenance Monitoring System. Author (GRA)

N81-33393# Harris Corp., Melbourne, Fla.
TENT SHAPED PHASED ARRAY Interim Report

C. A. Chuang Griffiss AFB, New York RADC Jun. 1981 70 p refs
 (Contract F19628-79-C-0173; AF Proj. 4600)
 (AD-A103927; RADC-TR-81-116) Avail: NTIS HC A04/MF A01 CSCL 09/5

This interim report presents the study results of a tent shaped phased array SHF aircraft antenna for Satellite Communications. The antenna consists of four planar phased arrays and has a low profile streamlined configuration. The tent array provides electrical scanning over a hemisphere and is capable of high power transmission. The design of the array is a trade-off of the key parameters including antenna coverage, gain, aerodynamic impact, high power transmission, and array packaging. The detailed design considerations of these parameters are presented. A design procedure is given to derive an optimum tent array configuration. The design of a 20 dB gain tent array is discussed. This array consists of square waveguide elements, septum polarizers, ferrite and diode phase shifters, a unique feed network, and a microprocessor for array control. The array depth has a significant impact on the aerodynamic effects and array packaging. The development and design of compact array components to reduce the array depth and to provide high power capability is the key factor to the successful application of the tent array. The extension of the 20 dB gain design to a 30 dB gain array is also included. A breadboard planar array, to test the performance of the array and components, and verify the concept of the tent shaped phased array, is being implemented in this effort. Author (GRA)

N81-33503# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
MANUAL ON THE FATIGUE OF STRUCTURES. 2: CAUSES AND PREVENTION OF DAMAGE. 7: MECHANICAL SURFACE DAMAGE

W. G. Barrois (l'Armement (Air), Vanves, France) Jun. 1981. 140 p refs
 (AGARD-MAN-10(ENG); ISBN-92-835-1389-4) Avail: NTIS HC A07/MF A01

Surface damage to aircraft structures is often the origin of fatigue cracks. Damage arising from decarburization and wheel grinding; friction and severe wear; rolling fatigue; contact fatigue; fretting fatigue; and erosion by solid and liquid particles and cavitation is examined. Damage in gears, cams, rails, and bearings are discussed as well as to the surface of metals transparent materials, reinforced plastics, and laminates. A.R.H.

N81-33945# National Aeronautics and Space Administration.
 Langley Research Center, Hampton, Va.

FLIGHT TEST OF A PURE-TONE ACOUSTIC SOURCE

Arnold W. Mueller and John S. Preisser Oct. 1981 39 p refs
(NASA-TP-1898; L-14600) Avail: NTIS HC A03/MF A01 CSCL 20A

Static and flight testing of a pure-tone acoustic source were conducted in order to: (1) determine if a 4-KHz tone radiated by a source in flight and mixed with broadband aircraft flyover noise could be measured on the ground with a high degree of statistical confidence; (2) determine how well a comparison could be made of flight-to-static tone radiation pattern and a static radiation pattern; and (3) determine if there were any installation effects on the radiation pattern due to the flight vehicle. Narrow-band acoustic data were measured and averaged over eight microphones to obtain a high statistical confidence. The flight data were adjusted to an equivalent static condition by applying corrections for retarded time, spherical spreading, atmospheric absorption, ground impedance, instrumentation constraints, convective amplification, and the Doppler shift. The flight-to-static results are in excellent agreement with the measured static data. No installation effects were observed on the radiation pattern. M.G.

N81-33946* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NOISE SUPPRESSION CHARACTERISTICS OF PERIPHERALLY SEGMENTED DUCT LINERS

Willie R. Watson Sep. 1981 43 p refs
(NASA-TP-1904; L-14521) Avail: NTIS HC A03/MF A01 CSCL 20A

The acoustic fields and transmission losses produced in semi-infinite circular ducts with peripherally segmented liners are analyzed using a series expansion of hard-wall duct modes. The coefficients of the series are computed using Galerkin's method. Unlike finite element approaches, this analysis includes the effects of realistic sources and the number of peripheral strips need not be small. It is shown that peripherally segmented liners redistribute the acoustic energy in waves composed of only a single circumferential mode at the source into other waves which contain a multitude of circumferential modes in the lined section. The accuracy of eigenfunctions computed from the analysis was observed to increase as either the frequency or radial mode order increased. The transmission losses were found to be accurate at frequencies above the cut-on value of the first-order radial mode in a hard-wall duct. The results show that for plane wave sources, peripherally segmented liners may attenuate as much sound as an optimized uniform liner at the optimal point while giving more noise suppression at most other frequencies. M.G.

N81-33947* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAM TO PREDICT AIRCRAFT NOISE LEVELS

Bruce J. Clark Sep. 1981 146 p
(NASA-TP-1913; E-733) Avail: NTIS HC A07/MF A01 CSCL 20A

Methods developed at the NASA Lewis Research Center for predicting the noise contributions from various aircraft noise sources were programmed to predict aircraft noise levels either in flight or in ground tests. The noise sources include fan inlet and exhaust, jet, flap (for powered lift), core (combustor), turbine, and airframe. Noise propagation corrections are available for atmospheric attenuation, ground reflections, extra ground attenuation, and shielding. Outputs can include spectra, overall sound pressure level, perceived noise level, tone-weighted perceived noise level, and effective perceived noise level at locations specified by the user. Footprint contour coordinates and approximate footprint areas can also be calculated. Inputs and outputs can be in either System International or U.S. customary units. The subroutines for each noise source and propagation correction are described. A complete listing is given. A.R.H.

N81-33948* Transportation Systems Center, Cambridge, Mass. **HELICOPTER NOISE ANALYSIS: ROUND-ROBIN TEST Final Report, Jan. 1980 - May 1981**

Edward J. Rickley Aug. 1981 79 p refs
(AD-A103724; TSC-FAA-81-13; FAA-AEE-81-13) Avail: NTIS HC A05/MF A01 CSCL 20/1

This report documents the results of an international round robin test on the analysis of helicopter noise. Digital spectral noise data of a 3.5 second simulated helicopter flyover and

identical analog test tapes containing helicopter noise data, reference signals, test tones and time code signals were sent to 13 participating organizations. The purpose of the test was to evaluate data reduction systems and procedures; to determine the magnitude of the variability between representative systems and organizations; and to identify potential causes and assist in establishing recommended procedures designed to minimize the variability. Author (GRA)

N81-34108# Department of Transportation, Washington, D. C. Office of Univ. Research.

PUBLISHED RESULTS OF THE PROGRAM OF UNIVERSITY RESEARCH. TRANSPORTATION RESEARCH RESULTS

Helen L. Whitfield and Russell A. Capelle 1980 61 p

(PB81-210130) Avail: NTIS HC A04/MF A01 CSCL 13F

This bibliography contains approximately 400 citations of published reports from transportation related research. Topics covered include automotive technology, energy efficiency and management, transport of hazardous materials, land use/economic impacts of transportation, and rail/guideway development. J.M.S.

N81-34109# Metropolitan Transportation Authority, Inc., New York.

DUAL-POWERED GAS TURBINE/ELECTRIC (GT/E) COMPUTER COMMUTER RAIL CARS: TEST, EVALUATION AND ECONOMICS Final Report

Donald Raskin, Charles Stark, and L. T. Klauder 5 Sep. 1980 52 p refs Sponsored in part by Urban Mass Transportation Administration, New York State Dept. of Transportation and AirResearch Mfg. Co.

(PB81-211757; UMTA-NY-06-0005-80-1) Avail: NTIS HC A04/MF A01 CSCL 13F

Eight prototype gas turbine/electric (GT/E) cars, four from the General Electric Co. (GE) and four from the Garrett Corp. were operated in revenue service on the Long Island Rail Road (LIRR). The design considerations that lead to the configuration of the GT/E cars and a description of the cars as built by GE and Garrett are presented. The costs of using GT/E trains to provide direct service to New York from select nonelectrified lines are compared with costs of extending electrification over those lines and operating conventional MU trains. Three rail lines are examined: the LIRR Port Jefferson and Oyster Bay branches, the Conrail's Upper Hudson to Poughkeepsie. GRA

N81-34138* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AMES RESEARCH CENTER PUBLICATIONS: A CONTINUING BIBLIOGRAPHY, 1981

Aug. 1981 261 p
(NASA-TM-81308; A-8655) Avail: NTIS HC A12/MF A01 CSCL 05B

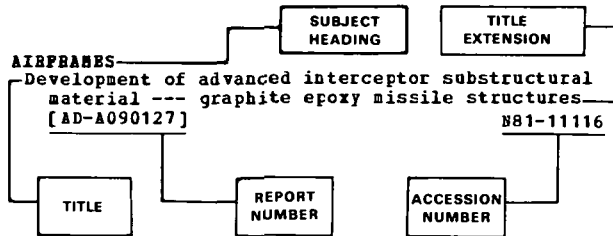
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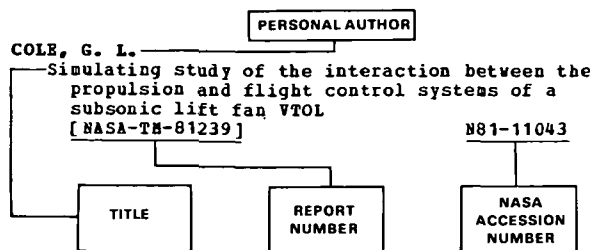
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